Significance

If you were to think about the differences between medieval and modern times, you would probably think first of the great difference in the material goods available. Today we have CD players, microwave ovens, and conveniences that medieval people never dreamed of. However, another and perhaps even greater difference exists: a difference in attitudes. Beginning in the 1300s, people gradually began to look for new ways to explain why and how things happened in the world.

Many historians believe that the changes in attitude that altered how people viewed themselves and their world grew out of a philosophical and artistic movement that began in Italy in the early 1300s. Because it centered on a revival of interest in the classical learning of Greece and Rome, we call this movement the Renaissance (REN-uh-sahnz), a French word meaning "rebirth."

Terms to Define

- Renaissance
- humanists
- perspective
- Reformation
- indulgences
- 95 theses
- sects
- predestination
- theocracy
- Counter-Reformation
- broadsides
- almanacs
- standard of living
- inflation
- Scientific Revolution
- scientific method
- geocentric theory
- heliocentric theory

People to Identify

- Niccolò Machiavelli
- Leonardo da Vinci
- Michelangelo
- Johannes Gutenberg
- William Shakespeare
- Martin Luther
- John Calvin
- Ignatius de Loyola
- Nicolaus Copernicus
- Galileo

Places to Locate

- Florence
- Zurich
- Venice
- Geneva
- Wittenberg

Chapter Theme Questions

- The Arts: How might the influx of new ideas affect the arts?
- Religion: What factors might have led to major shifts in religious thought?
- Science: How might a change in methods of investigation lead to an entirely new way of viewing the world?

On November 4, 1966, newscasts across the world carried reports of a staggering natural disaster. In northern Italy the Arno River had burst over its banks, sending torrents of swirling floodwaters cascading through the museums, cathedrals, and libraries of Florence. When the waters receded, they left layer upon layer of sewage and muck. Within days, hundreds of people converged on the waterlogged city to help with the massive cleanup.

Why would news of a flood in northern Italy electrify people across the world? Quite simply because that city contained the world's greatest store of Renaissance art and literature. One reporter noted:

"It is fair to say that much of what we know today of painting and sculpture, of architecture and political science, of scientific method and economic theory, we owe to the artists, politicians, statesmen, bankers, and merchants of the Renaissance—that explosion of intellectual and artistic energy in Italy between 1300 and 1600. And Florentines stood at the turbulent center of the Renaissance."

The outpouring of creativity that was the Renaissance changed the course of Western civilization.

Section 1

Renaissance Writers and Artists

Focus Questions

- What led to the Italian Renaissance?
- What were the characteristics of Italian Renaissance art?
- What were the characteristics of the Northern Renaissance in terms of humanist thought, literature, and art?

Scholars use the term Renaissance to refer not only to a philosophical and artistic movement but also to the period during which it flourished. The
Renaissance was a time of many developments, including the invention of the printing press, advances in science, and a new emphasis on reason.

**The Origins of the Italian Renaissance**

A renewed interest in Greek and Roman literature and life characterized the Renaissance. In many ways it was natural that this interest would reawaken in Italy. Ruins of the mighty Roman Empire served as constant reminders of Roman glory. The tradition of Rome as the capital city of a vast empire lived on in the popes, who made Rome the seat of the Roman Catholic Church. The Crusades and trade with Africa and Southwest Asia introduced new ideas and brought Italians into contact with the Byzantine civilization, whose scholars had preserved much learning from classical Greece and Rome. Arab and African developments in such disciplines as medicine and science fired the curiosity of many Italian scholars.

Italian cities such as Florence, Rome, Venice, Milan, and Naples had grown rich through trade and industry. Their citizens included many educated, wealthy merchants. In Florence, for example, the Medici (MED-ee-chee) family grew wealthy first as bankers and then as rulers of the city-state. As leader of Florence, Lorenzo Medici became a great patron of the arts and influenced Florence's artistic awakening.

**The Humanities**

Beginning in the 1300s, a number of Italian scholars developed a lively interest in classical Greek and Roman literature. Medieval scholars who had studied ancient history had tried to bring everything they learned into harmony with Christian doctrine. By contrast, the Italian scholars studied the ancient world to explore its great achievements. These Italian scholars stressed the study of grammar, rhetoric, history, and poetry, using classical texts. We call these studies the humanities; people who specialized in the humanities were called humanists. Humanists searched out manuscripts written in Greek and Latin. Often they would find more than one copy of a work. If the copies differed, humanists compared the different versions to try to determine which was most authentic. In doing so they displayed a critical approach to learning that had been lacking.

As humanists studied classical manuscripts, they came to believe that it was important to know how things worked. This belief led them to emphasize education. However, they also felt that a person should lead a meaningful life. Humanists became convinced that a person had to become actively involved in practical affairs such as patronage of the arts.

Humanists viewed existence not only as a preparation for life after death but also as a joy in itself. Along with a belief in individual dignity came an admiration for individual achievement. Many individuals of this period displayed a variety of talents, such as being both poet and scientist.

**Writers of the Italian Renaissance**

One of the first humanists, the Italian Francesco Petrarca (PEE-trahk), lived from 1304 to 1374. Like many of the humanists, Petrarca became famous as a scholar and as a teacher. He also wrote poetry, and his sonnets to Laura, an imaginary ideal
Machiavelli: Lessons in Statecraft

Niccolò Machiavelli is considered one of the most influential political writers of the Renaissance. While the political theorists of the Middle Ages wrote about politics in an idealistic way, Machiavelli strived to present the realistic side of politics in his work. His ideas were based on his perception of human nature from a historical context.

According to Machiavelli, an essential link existed between the condition of the state and the condition of the people. The state, he wrote, must be unified and efficient. If the state were divided and inefficient, drastic measures might be required to regain control.

Machiavelli's most well-known work, The Prince, was essentially a handbook on how to be a great ruler. Machiavelli believed that a ruler did not have to abide by traditional customs and morals but instead should be concerned only with power and success in political ventures. As an example of this new type of ruler, Machiavelli cited Cesare Borgia, who achieved political power through cruel and ruthless means. The Prince has often been considered a justification of the type of tyrannical leadership practiced by rulers such as Borgia.

In his essay, Machiavelli advised rulers to maintain the safety of their states by whatever means they thought necessary and not to let consider-

versity has arisen about this: whether it is better to be loved than feared, or vice versa. My view is that it is desirable to be both loved and feared; but it is difficult to achieve both and, if one of them has to be lacking, it is much safer to be feared than loved.

"For this may be said of men generally: they are ungrateful, fickle, feigners [liars] and dissimlers [deceivers], avoiders of danger, eager for gain. While you benefit them they are all devoted to you: they would shed their blood for you; they offer their possessions, their lives, and their sons... when the need to do so is far off. But when you are hard pressed, they turn away. A ruler who has relied completely on their promises and has neglected to prepare other defences, will be ruined, because friendships that are acquired with money, and not through greatness and nobility of character, are paid for but not secured, and prove unreliable just when they are needed.

"Men are less hesitant about offending or harming a ruler who makes himself less loved than one who inspires fear. For love is sustained by a bond of gratitude which, because men are excessively self-interested, is broken whenever they see a chance to benefit themselves. But fear is sustained by a dread of punishment that is always effective."
woman, are considered some of the greatest love poems in literature.

Petrarch's main influence, however, grew out of his desire for continuity with classical writers, whom he believed were committed to virtue in both public and private life. Petrarch thought these individuals could best be imitated if one studied their writings. The study of the writings of the ancient Greeks and Romans came to be called classical education. A command of classical languages, as they had been used by the ancient Greeks and Romans, became the mark of an educated person.

The humanists remained deeply committed to Christian teachings. For that reason, they sometimes felt a tension between their commitment to the study of the ancients and their commitment to Christianity. Petrarch, for instance, agonized over his lust for fame (a common Roman ambition) because he feared it would hurt his chances for salvation. Like most Italian humanists, Petrarch thought it important to lead a full and active life here on earth, even if that meant devoting less time to spiritual concerns.

Niccolò Machiavelli (mah-keh-YAY-vell-eh) of Florence, a diplomat and historian who lived from 1469 to 1527, ranks as one of the most illustrious of the many Renaissance writers. In 1513 he wrote a famous essay, The Prince, which described government not in terms of lofty ideals but as Machiavelli felt government actually worked.

Machiavelli can be considered a humanist because he looked to the ancient Romans for models and because such matters as the workings of politics interested him. However, the lack of concern for morality that he wrote about in The Prince set him apart from other humanists, who considered virtue their main aim.

Baldassare Castiglione (kahb-tel-yoh-nay) was an Italian diplomat and writer who lived from 1478 to 1529. In 1528 he published what was probably the most famous book of the Renaissance, The Book of the Courtier. Castiglione's work is a book on courtesy as well as an explanation of the role of the refined courtier as opposed to that of the coarse knight of the Middle Ages. As nobles lost their military role, Castiglione gave them a new idea of refined behavior. The setting for the book is the court at Urbino, an Italian city-state where the author lived many happy years. Castiglione's characters are real people who reflect in fictional conversations on how gentlemen and gentlewomen ought to act in polite society.

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**Italian Renaissance Artists**

Art in addition to literature flourished in Italy during the Renaissance. In an outburst of creativity, Italian artists produced some of the world's most exquisite masterpieces.

Medieval paintings stressed the world beyond everyday life—a world associated with religious subjects—and depicted formal and stylized figures. The most noticeable characteristic of Renaissance painting, on the other hand, is its realism. Renaissance painters depicted realistic and lifelike human figures in their paintings. Even the backgrounds of these paintings differed from those of medieval paintings. Earlier artists had portrayed the Holy Land. Renaissance painters showed the rugged countryside that they knew.

The success of many female Renaissance artists, such as Sofonisba Anguissola, was accepted only as a pursuit of "womanly virtue." Anguissola is best known for her self-portraits and for her portrait of Philip II.
Realism and Perspective

In the Middle Ages, paintings did not look particularly realistic. Almost all art was religious, and artists were not interested in drawing attention to the human nature of, for example, Jesus and Mary. Instead, artists tried to visually represent spiritual aspects of their subjects. For example, the relative size of figures or objects often showed their importance in a spiritual hierarchy.

With the Renaissance came a new interest in accurately depicting the beauty of the human form and the natural world. To be realistic, a painting had to create the illusion of distance and depth on a flat surface. In the early 1400s, a Renaissance architect named Filippo Brunelleschi performed a series of optical experiments to devise mathematical formulas for achieving perspective. Brunelleschi 'discovered' the laws of linear perspective, which explain how the human eye perceives distant objects as smaller than close ones. Renaissance painters soon began to use Brunelleschi’s rules of perspective in their works.

In The School of Athens (above), Raphael used precise, mathematical measurements and perspective techniques to render the architectural setting and the people within it. In this scene, which appears on a wall in the Vatican Palace in Rome, Plato and Aristotle are surrounded by other famous Greek philosophers.

Renaissance painters could make their works lifelike because they had learned a very important technique of painting called perspective. By making distant objects smaller than those in the foreground, and by arranging objects in certain ways, an artist could create the illusion of depth on a flat canvas.

Giotto (JAWT-oh), who lived from 1276 to 1337, and Masaccio (mah-ZAH-choh), who lived from 1401 to 1428, were important realist painters. According to legend, a fly in one of Giotto’s paintings looked so lifelike that an observer tried to brush it off. Masaccio used light and shadows to give the effect of depth to objects.

The late 1400s and early 1500s are often referred to as the High Renaissance. Among the many great painters of this period, four made particularly outstanding contributions to the arts.

Leonardo da Vinci (dah-VEEN-chhee)—painter, sculptor, engineer, architect, and scientist—lived from 1452 to 1519. Da Vinci used his experiments in science to enhance his painting. Studies of anatomy helped him draw the human figure, and mathematics helped him organize the space in his paintings. People throughout the world still marvel at his mural The Last Supper. Probably his most famous painting is the portrait called Mona Lisa.

Another master of Renaissance art, Michelangelo Buonarroti (mee-kay-LAHN-jay-loh bwaaw-nahr-RAW-tee), lived from 1475 to 1564. Millions of people have visited the Sistine Chapel of the Vatican, the residence of the pope in Rome, and looked with wonder at the frescoes Michelangelo painted on the ceiling.

Although he was a brilliant painter, Michelangelo preferred sculpture. Both his paintings and his stone carvings of such biblical figures as David and Moses suggest a massive dignity. Almost as versatile as da Vinci, Michelangelo also wrote poetry and worked as an architect, helping design St. Peter's Basilica in Rome.
Raphael (RAF-ee-uhl), who lived from 1483 to 1520, became so popular in Florence that the pope hired him to help beautify the Vatican by painting frescoes in the papal chambers. Raphael also painted exquisite madonnas, representations of the Virgin Mary.

Titian (TISS-uhn), who lived from about 1488 to 1576, spent most of his life in his native Venice. His works, such as The Assumption of the Virgin, portray a vivid sense of drama and are noted for their rich colors. The Holy Roman Emperor sponsored many of Titian's works, and he became one of the first painters to obtain wealth for his paintings.

Dozens of other artists prospered in Italy in the 1400s and 1500s. Princes supported many of these artists. The princes thought they would achieve lasting fame if they became patrons of the arts. Thus the patrons helped foster the enormous creativity of the period.

**The Northern Renaissance**

Humanist thought spread beyond Italy. Numerous mountain passes, such as the Brenner and the Great Saint Bernard, pierced the rugged Alps and allowed people—and ideas—to pass from Italy to northern Europe. The Danube, Rhone, and Rhine rivers provided even easier routes. New ideas, often carried by northern European students who had studied in Italy, soon traveled to Germany, the Netherlands, France, and England.

**Printing.** A remarkable new process—printing—also helped ideas spread. Hundreds of years earlier, the Chinese had learned how to create a wooden block into which writing or pictures could be etched. Printers applied ink to the block and pressed the block onto paper. Then the block was reinked. In this way the writing or pictures could be reproduced many times. The Chinese had also learned how to assemble the block from separate pieces, or type, that could be used again and again—movable type. The European invention of printing, however, appears to have been completely independent of the Chinese process.

Scholars believe that in about 1450, Johannes Gutenberg of Mainz, Germany, became the first European to use movable type to print books.
In 1508 Pope Julius II commissioned Michelangelo to paint the ceiling of the Sistine Chapel in Rome. Perched atop a new type of scaffolding that he had designed for the project, Michelangelo worked until 1512 to complete the commission. The result of his work has often been called the best example of Renaissance art in the world.

By studying the works of art produced during a specific period in history, we can learn much about the values of the people who created the art. Much of the art of the Middle Ages in western Europe, for example, reflects the religious nature of the society. The backgrounds of paintings focus not on real scenery but on heavenly backdrops, symbols, or gold reflections. People's faces reflect piety rather than individuality, and the figures themselves do not appear three-dimensional. Renaissance art retains religious themes while reflecting the humanistic and secular values of the time.

Developing the Skill
The illustration at the top of this page shows a detail from Michelangelo's The Creation of Adam on the ceiling of the Sistine Chapel in Rome. The painting reflects the values of the southern Renaissance.

The painting has a religious theme, similar to paintings of the Middle Ages. The subject is God's creation of Adam; however, the focus is on the humanity of Adam. Michelangelo captures Adam at the very moment that God holds out his hand to give life to his creation. Michelangelo portrays Adam as weak—but capable of receiving the gift of life from God. God, on the other hand, appears supremely powerful.

Based on the painting, what conclusions can you draw about values during the Renaissance? The painting shows the concern with religious themes, as does medieval art. Michelangelo, however, depicts figures as intensely human and realistic. The painting captures the beauty of Adam's face, his reflection of God's power and glory, and the noble individualism at the beginning of life. The painting shows that during the Renaissance people were intensely religious. At the same time, they believed in the dignity of human beings.

Practicing the Skill
Find and study an illustration of a modern work of art. Explain how this artwork reflects the values of modern society.

To apply this skill, see Applying History Study Skills on page 353.
Gutenberg developed a printing press on which he printed a number of copies of the Bible between 1453 and 1455. Other publishers adopted the printing press, and books soon helped spread new ideas to a large audience.

The most influential humanist of northern Europe was Desiderius Erasmus (eh-RAZ-muhs), who was a Dutch scholar. He learned about the ideas of the Italian humanists from printed books. Erasmus, who lived from around 1466 to 1536, entered a monastery as a young man. After his ordination into the priesthood, though, he left the monastery so that he could pursue his studies of the classics.

Unlike the Italian humanists, Erasmus and other northern humanists were interested in the early Christian period as well as in early Roman and Greek culture. Erasmus believed that in its early years, Christianity had existed in harmony with classical civilization. He applied to his study of the Bible the critical method that the Italian humanists had developed, and he argued for a return to the original, simple message of Jesus. Erasmus was saddened that the medieval scholars had made Christian faith less spiritual and more complicated and ceremonial. He published stinging criticisms of the church's lack of spirituality, as did other northern humanists.

Erasmus's most famous book, *The Praise of Folly*, ridiculed ignorance, superstition, and vice among Christians. Erasmus criticized fasting, pilgrimages to religious shrines, and even the church's interpretation of parts of the Bible.

Erasmus's friend Thomas More, the English humanist, took a similar view. In 1516 More published *Utopia*, a book in which he criticized the society of his day by describing an imaginary, ideal society. Here citizens lived together harmoniously. All citizens were equal, and everyone worked to support the society. More's Utopia became so popular that today utopia means "an ideal place or society."

**English literature.** Renaissance literature in England reached its peak in the late 1500s and early 1600s. William Shakespeare (1564–1616) stands out as the most prominent English literary figure of this period. Like many other playwrights, Shakespeare used familiar plots, but he built masterpieces of poetic drama around them.

Shakespeare portrayed personality and human emotions with a skill that few writers have ever matched. The moody Hamlet, the young lovers Romeo and Juliet, and the tragic Macbeth seem as real today as when Shakespeare first created them.

**Northern Renaissance Artists**

The dynamic new painting techniques of Italian artists inspired artists outside of Italy. Northern European merchants carried Italian paintings home, and painters from northern Europe studied with Italian masters.

In Flanders, a group of painters developed their own distinct style. The painters became known as the Flemish School. They are credited with perfecting the technique of painting in oils on canvas. The brothers Hubert and Jan van Eyck, who lived in Flanders until the mid-1400s, paid great attention to detail in works such as *The Adoration of the Lamb*, the altarpiece of the cathedral at Ghent.

One of the most famous Flemish artists, Pieter Brueghel (BROO-guhl) the Elder, painted in the mid-1500s. Brueghel loved the countryside and the peasants of his native Flanders and painted lively scenes of village festivals and dances. He also used his paintings as a means to criticize the intolerance and cruelty he saw around him.

The German artist Albrecht Dürer (DYUR-uhr), who lived from 1471 to 1528, was famous for his

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![Albrecht Dürer, a renowned German printmaker and painter of the Renaissance, depicted various biblical scenes in his works. This image shows the deposition or removal, of Christ from the cross.](image-url)
copper engravings and woodcuts. Advances in printing technology had already made mass production of books possible. Dürer became one of the first to see the possibilities of printed illustrations in books.

Although a German, Hans Holbein the Younger (c.1497-1543), did most of his work in other countries, Holbein traveled throughout Europe to paint portraits of famous people such as Erasmus, Thomas More, and King Henry VIII of England. This emphasis on portrait painting reflected the Renaissance interest in the individual.

**Section 1 Review**

1. Define Renaissance, humanists, perspective
2. Identify Niccolò Machiavelli, Leonardo da Vinci, Michelangelo, Johannes Gutenberg, William Shakespeare, Pieter Brueghel, Albrecht Dürer, Hans Holbein the Younger
3. Locate and Explain the Significance Florence, Venice
4. Analyzing Ideas What impact did humanist ideas have on the Italian Renaissance?
5. Understanding Ideas Describe the realism of Italian Renaissance art as related to the work of one Italian Renaissance artist.
6. Contrasting Ideas Contrast the Northern Renaissance with the Italian Renaissance in terms of humanist thought, literature, and art.

**The Origins of the Reformation**

The first break with the Roman Catholic Church occurred in Germany, where the political situation of the time helped lay the foundation for the Reformation. Unlike some countries during the early 1500s, Germany lacked a strong central government. Although Germany formed the core of the Holy Roman Empire, the empire included about 300 independent states. The weak emperor could not control independent ideas about religion within the German states or prevent abuses of power by the pope.

Pope Leo X continued the rebuilding of St. Peter's Basilica in Rome. An enthusiastic monk named Johann Tetzel was sent to raise funds in northern Germany. Using a technique that had become accepted in the church, Tetzel asked people to buy indulgences, or pardons from punishment for sin.

Indulgences, part of the sacrament of penance, had originally been a reward for exceptionally pious deeds, such as helping a poor person go on a Crusade. Renaissance popes, however, sold indulgences simply to raise money.

This misuse of indulgences appalled the northern humanists, who wanted the church to become more spiritual. The concern grew especially strong in Germany, where many political leaders gave sellers of indulgences great freedom of movement. One unhappy observer, Martin Luther, protested Tetzel's behavior in 1517.

**Martin Luther's Protest**

Martin Luther was born in 1483 to a moderately prosperous peasant family in the small mining community of Eisleben in Saxony. Luther's family made sure he received a good education. Although he planned to become a lawyer, as a young man Luther considered
himself a terrible sinner, and he worried desperately about the salvation of his soul. One summer day as he walked home, a sudden storm overtook him. A blinding bolt of lightning struck close by. Luther cried out, “Saint Anne, help! I will become a monk!” He gave up studying law to enter a monastery and spend his life in search of salvation.

Luther found that the church’s methods for overcoming sin gave him no comfort. He did all the things required of him, including making a trip to holy places in Rome. Nothing, however, relieved his feeling of damnation.

Through his biblical studies, a revelation, or new understanding, came to Luther. He came to believe that all the ceremonies and good deeds made no difference in saving a sinner. The only thing that counted, Luther felt, was an inner faith in God. As long as people did not rely on their own actions, but believed God would save them, they could receive salvation by God’s grace.

On the basis of this new insight, he developed beliefs that later became known as Lutheranism. Luther believed that a simple faith could lead everyone to salvation. He also believed that he had committed a grave theological error by asking poor people to give up their money for false promises of forgiveness.

In 1517 Luther challenged Tetzel by posting on the church door at Wittenberg 95 theses, or statements, about indulgences. Sales of indulgences began to decline. The news quickly spread across Europe that a monk had publicly challenged the selling of indulgences.

Luther clearly considered himself a reformer within the main tradition of the church. He was surprised at the widespread impact of his ideas, and had no wish to break with the church. But because he dared to challenge church practices, church leaders denounced him.

**Luther’s Break with the Medieval Church**

By 1520 Luther openly disagreed with many church doctrines. The sole religious authority, he said, was the Bible. Popes and bishops should not tell a person what to believe. Luther believed that ceremonies did not counteract sins and that priests had no special role in helping people to salvation. He felt that God viewed all people with faith equally. Luther considered his church a “priesthood of all believers.”

Taking advantage of the power of the printed word to spread ideas, in 1520 Luther wrote three publications that outlined his doctrines, attacked the pope, and called on all Germans to support his views. In 1521 Pope Leo X declared Luther a heretic and excommunicated him.

To put Luther’s punishment into effect, the Holy Roman Emperor Charles V summoned Luther to the Imperial Diet, a special meeting of the rulers of the empire, at the city of Worms (VOHRMZ). Luther was commanded to renounce his ideas. When he refused, the Diet of Worms banished him from the empire and prohibited the sale or printing of his works. Luther was now considered an outlaw. Because Germany lacked a strong government, however, the emperor could not enforce the Diet’s ruling. The Elector of Saxony, Frederick the Wise, protected Luther and provided a place for him to hide while the uproar caused by the confrontation at the Diet of Worms died down.

In 1522, while under the protection of Frederick the Wise, Luther translated the New Testament of the Bible into German. By 1534 he had translated
the entire Bible from Hebrew and Greek. Now all literate Christians that lived in Germany could read the Bible themselves.

Emperor Charles V continued to oppose Luther’s doctrines and did what he could to keep Lutheranism from spreading. The princes who supported Luther protested the emperor’s treatment of Lutheranism. Because of the protest, the followers of Luther and all later reformers came to be called “Protestants.”

Luther’s works continued to circulate, and his ideas continued to spread. In time he established a new church called the Lutheran Church. Luther kept the organization of the new church as simple as possible. Lutheran clergy, called ministers, had no special powers; they served merely to guide their congregations to the true faith. Ministers also had less importance than Catholic priests had, because Luther permitted only the two sacraments mentioned in the Bible—baptism and communion—rather than the seven sacraments practiced in the Roman Catholic Church.

Most of the sects later died out. The Anabaptists are somewhat of an exception. This sect believed that infants should not receive baptism because they could not understand the significance of the ceremony. Instead, they believed baptism should be offered only to adults who accepted the Anabaptist faith. The beliefs of this sect survive today in Mennonite and Hutterite religious communities.

The Anglican Church. In England the Protestant Reformation came about by entirely different means than in Germany. True, some Protestant ideas had filtered into England by the 1520s. The English also had a tradition of resistance to the popes that went back to John Wycliffe in the 1300s. However, King Henry VIII caused the break between England and the Roman Catholic Church between 1529 and 1536. The break was a political move that had little to do

The Spread of Protestantism
Luther had touched a very deep desire among the people of Europe for a simpler, more direct faith. Within a short time after he took his stand, many rulers in the German states established the Lutheran Church within their domains. In addition, dozens of other reformers appeared who were dissatisfied with both the Roman Catholic Church and the Lutheran Church.

Charles V attempted to stop the spread of Protestantism, but for about 10 years he was too busy fighting the Ottoman Turks and the French. Then in 1546 he sent his armies against the Protestant princes in Germany for both religious and political reasons. The emperor won most of his battles with the princes, but in the end he could not defeat them or the Lutheran Church. Charles V finally reached a compromise with the princes with the signing of the Peace of Augsburg in 1555.

One of the provisions of the Peace of Augsburg stated that each German ruler had the right to choose the religion for his state. His subjects had to accept the ruler’s decision or move away. Almost all the princes of northern Germany accepted Luther’s faith.

The sects. Hundreds of new religious groups emerged throughout Germany and Switzerland in the 1520s and 1530s. These groups, known as sects, did not form organized churches with clear-cut rules, authority, discipline, and membership. The sects were societies of a few people gathered together, usually with a preacher as their leader.

This manuscript page illustrates the restoration of a statue of Mary that had been destroyed by violence during the Reformation.
with religious doctrine. In fact, before 1529 Henry VIII had defended the church so well against Martin Luther’s ideas that the pope had granted Henry the title of “Defender of the Faith”—a title that the present monarch of England still bears.

England’s break with Rome took place because Henry VIII wanted to divorce his wife, Catherine of Aragon, for not producing a male heir to the throne. The king believed that a continuing strong monarchy depended on having a son to succeed him. The royal couple had a daughter, Mary, but England had no tradition of a ruling queen. Furthermore, Henry wanted to be rid of Catherine and to marry Anne Boleyn, a lady-in-waiting at the court.

Although the Catholic Church forbade divorce, the pope could make exceptions. Pope Clement VII, however, refused to dissolve Henry’s marriage. Clement made his decision in part because troops led by Catherine of Aragon’s nephew, the Holy Roman Emperor Charles V, had captured and sacked Rome in 1527.

Pope Clement’s refusal to grant the divorce infuriated Henry, who withdrew England from the Catholic Church and created a new church. In a series of laws, Parliament created the Church of England with the king as its head. Although the Church of England, or Anglican Church, slowly acquired some Protestant doctrines, it kept the organization and many of the ceremonial features of the Catholic Church.

Of course, Henry VIII’s church granted his divorce. The king eventually married six times in all. He finally fathered a son, the future Edward VI, although not by Anne Boleyn. More important historically, by creating the Anglican Church he opened the way for the Protestant Reformation in England.

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**Section 2 Review**

1. Define Reformation, indulgences, 95 theses, sects
2. Identify Martin Luther
3. Locate and Explain the Significance Wittenberg
4. Understanding Ideas What specific issue sparked the Reformation in Germany?
5. Contrasting Ideas What were the main differences between Luther’s ideas and those of the Roman Catholic Church?
6. Summarizing Ideas Describe how Protestantism spread beyond Germany.

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**Section 3**

**The Catholic Reformation**

**Focus Questions**

- Who was John Calvin? What role did he play in the Reformation?
- What steps did the Catholic Church take to respond to Protestant reform?
- What was the approach used by the Jesuits to Catholic reform?

Although areas of northern Europe became Protestant during the Reformation, millions of Europeans remained faithful to the Roman Catholic Church. Change and challenge continued, however, even in countries such as France, where the Catholic faith remained strong. After 1550 the religious conflict in Europe was dominated by the followers of a French-born reformer named John Calvin and a remarkable Catholic revival known as the Counter-Reformation.

**Calvin and Calvinism**

Huldrych Zwingli (TSVING-lee), the vicar at the cathedral in Zurich in the early 1500s, was greatly influenced by the humanist writings of Erasmus. Zwingli was stirring up religious reform in Switzerland when he heard about Luther’s 95 theses. Zwingli and Luther met and discovered that they agreed, more or less, on doctrine but disagreed about forms of worship and the use of images. Zwingli’s supporters, for example, covered up wall decorations in churches.

In 1531 Zwingli died in a battle between Catholics and Protestants, but the French Protestant John Calvin carried on the work of the Reformation in Switzerland. Calvin founded a Protestant church that had a strong following. He formulated a complete and clear set of beliefs, the Institutes of the Christian Religion, published in 1536. This work laid down exactly what the faithful ought to believe on every major question of religion. Calvin thus provided his followers—Calvinists—with a code that united them and strengthened them against opposition and persecution.

In 1536 Calvin settled in the city of Geneva, where Calvinism became the official religion. Calvin retained Luther’s reliance on faith and on the Bible. He also placed added emphasis on the belief, common among Protestant theologians during the 1500s, that God had decided, at the beginning of time, who
would be saved—a belief known as **predestination**. Those predestined (or chosen beforehand) for salvation were called “the elect.” They formed a special community of people who were expected to follow the highest moral standards. These standards placed great emphasis on devoutness and self-discipline and frowned on frivolity. The individual was to possess a complete dedication to God’s wishes.

Calvin became very influential in Geneva. The city became a **theocracy**, or a government ruled by a clergy claiming God’s authority. By attaching such great importance to righteous living, the lives of the citizens were regulated down to the smallest detail. Laws prohibited dancing, card playing, showy dress, and profane language. Violation of these laws resulted in severe punishment.

Calvinism soon spread to France, where its converts became known as Huguenots (HYOO-guh-nahnts). Although France remained primarily Catholic, Calvinists controlled nearly one third of the country at one point. Many high-ranking nobles as well as townspeople adopted the Calvinist doctrines. The Catholic French monarchs considered the Huguenots a threat to national unity.

Beginning in 1562 the Huguenots defended themselves in a series of bloody civil wars with the Catholics. In 1598 King Henry IV issued the Edict of Nantes (NANTS), which gave the Huguenots freedom of worship and some political rights.

Calvinist minorities also existed in Poland and Hungary in eastern Europe. The Calvinists met with the most success, however, in Scotland, in the northern Netherlands, and in some parts of Germany. In these countries the strength of the Calvinists among the people persuaded rulers to change their views. In a form called **Puritanism**, Calvinism would play a vital role in England and in its North American colonies. By 1600 the Calvinist churches were among the strongest of the many Protestant churches established in Europe.

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From 1536 until his death in 1564, John Calvin was instrumental in the foundation of Protestantism in Geneva. This is a map of Geneva during the time of Calvin.
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The Counter-Reformation
It took some time for the Catholic Church to recognize that Protestantism posed a serious threat. The pope at first dismissed Luther's criticisms. A number of people within the Catholic Church, including Erasmus, had called for internal reforms even before Luther appeared. As the breakup of the church continued, these reformers eventually convinced the pope of the drastic need for change.

In the 1530s a major reform effort known as the Counter-Reformation, or the Catholic Reformation, began in the Catholic Church. Initially created to foster a more spiritual outlook in the Catholic Church, the Counter-Reformation also clarified the doctrines of the church and pursued an aggressive campaign against Protestantism.

Counter-Reformation tactics. Pope Paul III, who reigned as pope from 1534 to 1549, began a deliberate policy of reviving a more spiritual outlook in the Catholic Church. To accomplish this, he appointed devout and learned men as bishops and cardinals.

Pope Paul III also brought the medieval Inquisition to Rome. Spanish authorities had been trying and punishing so-called heretics since 1478. The Inquisition borrowed its cruel punishments, such as burning at the stake, from government, which had used such methods against the war criminals and traitors. The leaders of the Inquisition did not see themselves primarily as punishing Protestants but rather as keeping Catholics within the church.

In 1559 Pope Paul IV introduced another method of combating heresy. He established the Index of Forbidden Books, which forbade Catholics to read certain books that were considered harmful to faith or morals. The Index was a recognition of the role printing had played in spreading the Reformation. Before the printing press, the church could easily find and burn manuscripts of heretical works. After printing was developed, it became far easier to forbid people to read certain books than to burn the books. The Catholic Church maintained the Index until 1966, when the Second Vatican Council finally abandoned it.

The Council of Trent. Pope Paul III knew that no counterattack against Protestantism would be possible unless Catholic doctrines were well defined. Church authorities often disagreed about complicated doctrines, which made it difficult to take a stand against opposition. In 1545 Paul summoned church leaders to the Italian city of Trent. The Council of Trent, which met in three sessions from 1545 to 1563, defined official church doctrine with the same precision Calvin had used to define his faith.

The Council of Trent banned the sale of indulgences and tightened discipline for the clergy. In most cases, however, the council reaffirmed the importance of those doctrines that Protestants rejected. It emphasized the need for ceremonies, arguing that God ought to be worshiped with pomp and splendor. It noted that people must depend on priests because God granted forgiveness only through the church. The council stressed that although everyone enjoyed free will, a person's fate after death depended not only on his or her faith, as Luther claimed, but on ceremonial church actions as well.

The decisions made at the Council of Trent were effective for the Catholic Church. Many people
found Protestantism's simplicity and austerity appealing, but many others took comfort from ancient ceremonies, beautifully decorated churches, the authority of priests, and the idea that one could perform good works to gain salvation.

**Soldiers of the Counter-Reformation**

A new aggressiveness on the part of the Catholic Church became a major reason for the success of the Counter-Reformation. This aggressiveness took many forms. Better-educated priests worked more forcefully for the church. The old religious orders reformed their rules, while new religious orders such as the Society of Jesus, known as the Jesuits, formed.

Ignatius de Loyola founded the Jesuits in 1534. Loyola was a Spanish soldier whose leg had been shattered fighting for Charles V against the French. Loyola's long period of recovery from his injury gave him time to read about the lives of Jesus and the saints. Like Martin Luther, Loyola wondered how he could attain salvation despite his sins. The answer came to him in a vision that he recorded in his book *Spiritual Exercises*. According to Loyola, salvation could be achieved by self-discipline and by doing good deeds—in other words, by one's own actions. Loyola convinced six fellow students at the University of Paris to take religious vows of poverty, chastity, and obedience to the pope and to follow him. Less than 10 years after Loyola founded his group, Pope Paul III recognized it as an official order of the Catholic Church.

Loyola organized the Jesuits like a military body, with discipline and strict obedience. He was the general of the order; the members were his soldiers. The Jesuits quickly became the most effective agents in spreading Catholicism. By 1556 the order had about 1,000 members. Their missions took them as far away as China and Japan. In Europe their preaching and their hearing of confessions slowed the spread of Protestantism in Poland, Germany, and France.

The Jesuits stressed education. They founded some of the best colleges in Europe, combining humanist values with theology to turn out learned, fervent supporters of the church.

Although some people had cherished hopes that the Reformation would bring about a new spirit of tolerance, the period from the 1530s through the mid-1600s was a time of devastating religious wars, sometimes interrupted by long truces, in Germany, Switzerland, France, and the Netherlands. Not until the mid-1600s, when the wars ended, could the results of the Reformation and the Counter-Reformation be fully seen.

**Results of the Religious Upheaval**

The most striking result of the religious struggle of the 1500s was the emergence of many different churches in western Europe. In Italy, although Protestantism never made much headway, interest in church reform remained strong. Most of the people of southern and eastern Europe and the native population of Ireland remained firmly Catholic. France and the Netherlands had large numbers of Protestants. In Switzerland, northern Germany, England, Scotland, Norway, Denmark, and Sweden, various Protestant faiths became the established church, backed by the central government (see map on page 340).

Another far-reaching result of the Reformation and Counter-Reformation was a new interest in education. Many new universities had appeared in the 1400s and 1500s because of the humanists' concern for learning. After the mid-1500s enrollments in
Learning from Maps  Although the Reformation gained many converts in northern Europe, southern Italy remained predominantly Catholic.

Region  What religions were dominant in Scotland? Norway? England?

these universities increased dramatically; religious reformers supported this trend.

Protestants believed that people could find their way to Christian faith by studying the Bible. As a result, reading became increasingly important. In their schools the Jesuits and other new religious orders worked to strengthen the faith of the Catholics. Education did not mean tolerance of new ideas, however. Neither the Protestant nor the Catholic authorities permitted views that differed from their own.

The Reformation led to an increase in power of national governments and a decrease in power of the pope. In Protestant regions each government took responsibility for the leadership of the official church. In Catholic areas, rulers loyal to the pope often obtained considerable control over their churches.
Section 3 Review

1. Define predestination, theocracy, Counter-Reformation
2. Identify John Calvin, Ignatius de Loyola
3. Locate and Explain the Significance Zurich, Geneva
4. Understanding Ideas What were the main ideas of John Calvin and how were they expressed in the government of Geneva?
5. Summarizing Ideas Describe how the Catholic Church responded to the Reformation, including the role of the Council of Trent.
6. Analyzing Ideas Why were Ignatius de Loyola's efforts to strengthen the Catholic Church successful?

Section 4

Culture and Daily Life

Focus Questions
- What were the characteristics of village life in Europe during the period of time known as the Renaissance and Reformation?
- How did villagers learn about the world outside their villages?
- What changes in daily life occurred in the 1500s and 1600s?

The ideas that shaped the Renaissance, the Reformation, and the Counter-Reformation involved relatively few people. Ordinary people had their own views about themselves and the world around them.

Magic and Witchcraft
Most Europeans lived in or near small villages and spent their entire lives combating nature to raise food. People close to the land could never predict what life would bring. They never knew when a cow might suddenly fall ill, when lightning might burn down a cottage, or when churning would fail to turn milk into butter.

The world of spirits. Since people considered God to be a distant, unknowable force, they thought spirits populated the world. Although good spirits abounded, demons, or devils, made life difficult. Because of this belief in spirits, nothing was considered an accident.

If lightning struck a house, a demon had caused it. If a pitcher of milk spilled, the evil work of a demon was the cause. Many "superstitions," such as the belief that walking under a ladder might bring bad luck, began during this period.

Village priests usually accepted these beliefs or at least pretended to ignore them. To the ordinary villager, the priest's explanation that the misfortune was God's will or God's punishment for sin was not very satisfying. Nevertheless, villagers believed that the priest's actions could have positive effects. For example, every spring in a special ceremony, the priest would go out to the fields to bless the earth and pray for good crops. His blessing of a husband and wife at a wedding supposedly gave the couple a good start in life, and baptism was thought to safeguard a newborn child.

The priest, however, was not the only person to whom the villagers turned in times of trouble. They also looked to a so-called "wise" or "cunning" man or woman. This person, usually an older village member, was thought to have a special understanding of the way the world operated. Ordinary people would explain their problem—a lost ring, a cruel husband, a sick pig, or even an ominous sign—to these "wise" folk. Since people believed nothing happened by accident, anything unusual, such as a frog jumping into a fishing boat, was taken as a warning. The wise man or woman would explain what the warning meant and would sometimes recommend a remedy to ward off evil. The remedy might include wearing a good-luck charm, chanting a strange spell, or drinking a special potion.

The belief in witchcraft. Wise people were often called "good witches." However, if their relationship with their neighbors turned sour, wise people might be accused of being "bad witches." In many cases the person accused of witchcraft would be an elderly widow. Perhaps too weak to work, with no husband or family to support her, she would be the most defenseless person in the community and an easy target for attack.

Stories about witches became more sensational as they spread throughout the countryside. Outrageous accusations were made. A person might be accused of flying on a broomstick, sticking pins into dolls, or dancing with the devil in the woods at night. If the majority of people believed an accusation, a priest might be asked to hold a ceremony to exorcise, or drive out, a demon that was thought to have taken over the witch's body. In other cases, the accused person might be dragged to a bonfire, tied to a stake, and burned, perhaps with the approval of the local lord.
An enormous outburst of “witch hunting” occurred in Europe in the mid-1500s and lasted for more than 100 years. Both religious and secular leaders were ready to see the existence of witches as an acceptable explanation for the problems in the world around them. Eventually, however, as the religious wars came to an end and people experienced greater security in their lives, fewer cases of witchcraft were reported.

**Forms of Recreation**

For most people, daylight meant work and night meant sleep. Because manual farming methods were slow, people needed all their daylight hours for raising food. Evening activities were limited because the farmers were exhausted from working all day and because they could not afford the candles needed for light. Still, they did find time for relaxation.

Every village had a gathering place where people came together to drink, sew, do simple chores, and tell stories. Some people played games such as skittles (a form of bowling). Occasionally, traveling companies of actors passed through a village and put on a simple show. The year contained many special days. The church decreed some holidays. Others honored a local saint or tradition. During some holidays, the villagers donned costumes and would often put on their own ceremonies.

A favorite ceremony poked fun at the familiar sights and scenes of village life. In different parts of Europe, this ceremony had different names. Whether it was called “rough music,” “charivari,” or “abbes of misrule,” the basic ceremony was much the same. The young men of the village formed a procession and marched along, ridiculing accepted customs or the foolish people of the village. For example, two young men might impersonate a couple known to everyone because the wife beat the husband. The impersonation would be pulled along in a cart and, as they passed by, the other villagers would jeer and hoot at them.

Sometimes the marchers had more serious targets; they might want to show how things would look if the poor or the weak had power. They would dress a fool like a bishop, or they would put the poorest man on a throne. At this point, the jokes lost their lightheartedness and symbolized the resentment the villagers felt about the privileges of those who ruled them.
People throughout the ages have played games for amusement and diversion. In some cultures, games were a way for children to learn skills that would be useful to them in later life. In addition, games provided relief and relaxation from the routine of hard work in the home or the fields.

Dice have been found in Egyptian tombs. The modern game of backgammon developed from a board game played in Mesopotamia, and chess probably was first played in India.

More than 400 years ago, the Flemish artist Pieter Brueghel painted the large picture shown here (above). The picture is almost an encyclopedia of the games played by children of Brueghel's time. Brueghel loved to show the activities of peasants and working people. This painting depicts at least 80 games, including everything from marbles to hockey to ring-around-the-rosy and hoop rolling.

Many games are played by adults as well as by children. Baseball, for example, can be a pickup game in a neighborhood park or a schoolyard, or a competition among professional athletes. In recent years people of all ages have been fascinated by the new games and twists on old games that electronics and the computer have made possible.

The wide appeal of games to people of all ages may account for a feature of Brueghel's painting that has never been explained. Some people think that all the people playing games in his paintings look like adults. Perhaps Brueghel wanted to suggest that adult activities are no different from the games that children play. However, we cannot know for sure. What we do know is that many of these games and activities are still amusements today (center), for children as well as for grownups throughout the world.
Violence and Protest in the Village
Villagers lived in close-knit communities. Anyone who seemed to upset their traditions or their sense of proper behavior was treated harshly. The strain of hardship or famine could cause villagers to respond, sometimes violently.

The women of the village often led these protests. Because women were responsible for feeding their families, they especially felt the impact of taxes or food shortages. If the women suspected, for example, that a baker hoarded bread or sent it elsewhere for higher profits, they might ransack the baker’s shop.

On the other hand, people of this time tended to identify closely with other members of their community. In large communities, such as towns, this might mean members of one’s profession. In smaller villages, whole communities tended to work and make decisions together.

Printing and the Spread of Knowledge
In the 1500s the world beyond the village began to affect village life. Printed works and, in some areas, traveling preachers, inspired the changes.

Few ordinary villagers could read. Often even the village priest could not read. Nevertheless, soon after the invention of movable type, publishers started selling popular works. Single printed sheets known as broadsides began to appear. A broadside might include a royal decree or news of some sensational crime or other event. Books and broadsides arrived in the village, carried by peddlers who brought goods from the outside world. When the villagers gathered together, they might enjoy listening to someone read the latest broadside.

While romances and epics of the classical age appealed to the nobility, publishers quickly found subjects that appealed to country folk and produced cheap books for this new market. The most common books were almanacs, the ancestors of The Old Farmer’s Almanac of today. In the almanacs were predictions about the weather and the prospects for growing crops. Almanacs also contained calendars, maps, and medical advice. The books were best-sellers because they spoke to the beliefs and concerns of the ordinary people.

Soon after Luther's break with the church in 1517, new religious ideas reached the villages. Sometimes preachers came to visit. Books might come out of the peddlers' packs. Perhaps people heard stories that attacked the church in the village gathering place. Certainly the messages of Luther and Calvin traveled in this way, as did translations of the Bible.
What if Europeans had not developed movable type until about 1600? How might that have affected the course of the Renaissance? The Reformation? The Counter-Reformation?

As Protestants and Catholics battled for the loyalties of ordinary people, leaders of both sides encouraged the founding of primary schools in the villages and towns. Both Protestant and Catholic leaders believed that knowledge would lead a person to support their faith. In spite of this common concern for education, the followers of the differing religions struggled to coexist peacefully. Neither side, unfortunately, included tolerance in its teachings.

Changes in Daily Life
In addition to undergoing religious and political changes, Europeans experienced economic changes as well. The measure of the quality of life of a person or a country is called the standard of living. The standard of living is not strictly limited to income or economic output; it also includes working conditions, home life, the environment, health, and leisure.

Population and Inflation. After the Black Death of the 1300s cut Europe's population by at least one third, some peasants prospered. There were fewer people to cultivate the land, so their labor was in demand. This often resulted in higher wages.

By 1550, when the religious wars had begun to savage Europe, conditions changed. The population was growing rapidly. With the growth of the population came inflation, a rise in prices for goods. After 1550 wages could not keep up with the rise in prices, especially of farm products.

Diet. During this period, white bread made from wheat was a rarity. Meat was scarce and expensive, and fish only a little less so. Salt, needed to preserve fish and meats, had long been an important item of trade in Europe, but was still costly. Cheese and eggs, cheap sources of protein, were an important part of the diet everywhere. Butter was not widely used outside northern Europe until the 1700s.

The spices that had earlier come to Europe from the East had been largely luxury items. By the 1500s and 1600s, however, the importation of spices had become highly competitive. In the 1500s traders began introducing Europeans not only to new vegetables—asperagus, spinach, lettuce, green beans, tomatoes, and melons—but also to the luxuries of coffee, tea, and chocolate.

Not everyone had access to the new and varied diets. Wealthy people still lived better than most of the peasants and the urban poor, who for the most part ate the same simple meals they had eaten for centuries.

The table settings and customs that we know today were not common in the early Renaissance period. People ate mostly with their fingers, picking what they wanted from a large common dish. In some areas people ate from wooden plates. Guests brought their own knives; individual forks did not come into use until the 1500s, and spoons not until a century after that.

Housing. Brick and stone became more common construction materials in the growing cities of Europe after the 1500s. In the countryside, however, peasants continued to live in thatched-roof cottages as they had in the Middle Ages. Most rural houses were small. Because glass was expensive and sometimes not available even for the wealthy, most houses had shutters rather than glass windows.

Peasants' houses boasted only the necessities of rural life—a large cooking pot, a table, a bench, and a few tools. Those who were fortunate had a bed; others slept on sacks filled with straw. Entrenched in poverty, with little hope of escaping their fate, many peasants sought refuge in the cities.

The Decline of Traditional Culture
The migration from countryside to city further altered traditional popular culture. In the city, food came from a shop rather than directly from a field. Local governments helped out when disaster occurred. If famine struck, authorities distributed bread. If plagues broke out, the government would set up hospitals and quarantines.

Gradually, more sophisticated attitudes began to take hold among the residents of towns and cities. In particular, people's understanding of how things happened in the world began to change. Demons and spirits no longer dominated views of daily life. People sought rational explanations for day-to-day events, and there now seemed less need for magic and "wise" folk. This development has been referred to as the "disenchantment" of the world—the removal of "enchantment," or magic, from nature. One of the most important influences on the growth of this new attitude was the cultivation of modern science.
knowledge is now called science. Before the 1600s, the word science meant “knowledge.” After the 1600s, the sense of the word evolved into the narrower meaning it has today.

**Experiments and Mathematics**

The Europeans’ ideas about the universe had come to them from the ancient Greeks and Romans. People considered Aristotle and Galen to be absolute authorities who knew the truth. However, as the humanists unearthed more classical manuscripts, they found that even the respected ancient writers did not agree with each other. As people began to examine the world around them, they made observations that did not correspond to ancient beliefs.

As a result, people in the 1500s began to question traditional opinions. They began to observe and experiment for themselves. Most importantly, they described nature without any reference to previous beliefs. The foundation of this approach was the principle of doubt: nothing was to be believed unless it could be proved by experiment or mathematics. The transformation in thinking that occurred during the 1500s and 1600s as a result of this new system of investigation is known as the **Scientific Revolution**.

The new approach relied heavily on the scientists’ ability to conduct scientific experiments. Scientists had access to newly invented instruments, such as the barometer, the microscope, and the thermometer, which improved their ability to observe and measure. At the same time, improved mathematical calculations became essential to investigations of nature. The method of inquiry that includes carefully conducted experiments and mathematical calculations—to verify the results of these repeatable experiments—is called the **scientific method**. The scientific method also involves making logical deductions from self-evident principles.

**Astronomy, Physics, and Anatomy**

New frontiers in science attracted people with interests in different fields of study. Five Europeans in particular—Copernicus, Kepler, Galileo, Vesalius, and Harvey—became pioneers of modern astronomy, physics, and anatomy.

**Copernicus.** For centuries astronomers had believed in the theory Ptolemy put forth in about A.D. 100. Earth was the center of the universe and the other planets and the Sun moved around it. Ptolemy’s theory is called the **geocentric** (“Earth-centered”) **theory**, from the Greek words ge, meaning “Earth,” and kentron, meaning “center.”
In the early 1500s, a Polish scientist named Nicolaus Copernicus discovered ancient writings arguing that the Sun was the center of the universe. Copernicus's theory developed as the heliocentric theory, from the Greek word hēlos, meaning "sun." After a long period of study and observation, Copernicus became convinced that the heliocentric theory best explained all the known facts of astronomy of his time. In 1543 Copernicus published his conclusions in a book titled *On the Revolutions of the Celestial Spheres*.

The book caused little stir at the time. Few people believed in the heliocentric theory because it seemed to contradict the evidence of the senses. Anyone could "see" that the Sun and planets moved around Earth. Anyone could "feel" that solid Earth did not move.

Copernicus could not test and prove the heliocentric theory with the instruments or the mathematics available to him. Proof had to wait for the work of two later scientists, a German named Kepler and an Italian named Galileo.

**Kepler and Galileo.** Johannes Kepler, who was a brilliant mathematician who lived in the late 1500s and early 1600s, used mathematics to test the heliocentric theory of Copernicus. At first Kepler could not make the theory fit the observed facts. It is said that he calculated the problem many times before he discovered the solution. Copernicus had written that Earth and other planets went around the Sun in orbits, or paths in space, that were exact circles. Kepler discovered that the orbits were not exact circles, they were ovals called ellipses. Now other facts made sense. The heliocentric theory of the universe could be supported mathematically.

Because Kepler’s proof could not be seen or observed, only mathematicians understood it. An Italian professor of mathematics and astronomer, Galileo Galilei, provided concrete evidence that Earth revolves around the Sun.
Galileo had read of a Dutch eyeglass-maker who put two glass lenses together in a tube to make a telescope. By looking through the telescope, a person could see distant objects more clearly. Galileo made a telescope for himself. By modern standards Galileo’s telescope was only a small one, but it allowed him to see more of the heavens than anyone had ever seen. He could see the mountains and valleys of the moon and the rings around the planet Saturn. He observed sunspots. He proved that Earth rotated on its axis. His discovery that the moons of Jupiter revolve around the planet helped disprove the geocentric theory of Ptolemy by showing that not every heavenly body revolves around Earth.

Galileo published his findings in 1632 in a work called *Dialogue on the Two Great Systems of the World*. His work, unlike that of Copernicus, caused an uproar. Many people now wanted telescopes. Many others believed telescopes to be the devil’s work and refused to have anything to do with them. Scholars who accepted the authority of Ptolemy refused to believe the heliocentric theory. The church disapproved because the theory seemed to contradict the Bible. The church further insisted upon its right to condemn any scientific explanations that differed from scripture. In 1633 the Inquisition summoned Galileo to Rome, where it ordered him to renounce his belief that Earth moves around the Sun. Galileo did as he was asked, but legend tells us that as he rose from his knees before the Inquisition he muttered, “Yet the earth does move.” The new ideas continued to advance.
The Microscope and the Telescope

Repeated experimentation and careful measurement—so vital to the scientific method—were greatly aided by the development of new technology. Two of the technological innovations of the Renaissance—the microscope and the telescope—expanded human sight in amazing ways. One allowed scientists to look inward at the minute structures of the human body. The other opened the door to the universe beyond.

Engravers, workers in fine detail, are thought to have been the first to capture water in glass globes and gaze through it as a magnification aid. Lenses appeared in the late 1200s. It is not surprising therefore that three spectacle-makers, Zacharias Janssen, his father Hans, and Hans Lippershey, have been credited with developing an early microscope with simple lenses in the final decade of the 1500s. Less than 100 years later, in the 1670s, Anton van Leeuwenhoek had devised a microscope that allowed him to see bacteria of only 2 to 3 micrometers in diameter.

Galileo, in 1609, was the first to use the compound lenses of a telescope to view the skies. The telescopes that he built were larger and more powerful than any that had been built before. What he observed with his telescope confirmed Galileo's belief in the heliocentric views of Copernicus. Both these inventions, developed within twenty years of each other, were to open the eyes of science for centuries to come.

Galileo was interested in physics as well as astronomy. Perhaps the most remarkable of his discoveries disproved the popular belief that heavier bodies fall faster than lighter ones. Galileo proved mathematically that, in the absence of air friction, all objects fall at the same speed regardless of their weight. This discovery laid the foundation for the modern science of mechanics, the study of matter in motion.

Vesalius and Harvey. Andreas Vesalius, a Flemish scientist, pioneered the study of anatomy. Vesalius refused to accept the descriptions of human muscles and tissues that Galen had written 1,400 years earlier. Vesalius conducted his own investigations to see how the human body was constructed. In 1543, the same year that Copernicus published his book, Vesalius published a landmark work in the history of medicine called On the Fabric of the Human Body.

Equally important was the work of William Harvey, an English physician. Using laboratory experiments, Harvey described the circulation of the blood through veins and arteries, the working of the body's most important muscle—the heart, and the function of the blood vessels.

The Triumph of Science

The effects of these discoveries were felt throughout Europe. So much had been accomplished. Knowledge had advanced so far that the scientists' methods became examples for everyone.

Just as new religious orders of the Counter-Reformation spread the revived faith in the church, scientific "orders" helped spread developments of the Scientific Revolution. In Rome there was the Accademia dei Lincei, founded in 1603. King Charles II granted a charter to the Royal Society in London in 1662, and Louis XIV established the French Academy of Sciences in 1666. The printing press helped the scientists just as it had the religious
reformers. Most societies published journals so that scientists everywhere could read of work being done throughout Europe.

Descartes. One of the most influential advocates of science was René Descartes (day-KAHRT), a French philosopher and scientist who lived from 1596 to 1650. Educated at a Jesuit college, Descartes decided to become a soldier in order to learn more about the world around him. He saw little fighting as a soldier and thus had ample time to think.

Descartes believed that one should question all assumptions before accepting them. He decided to start fresh with a new philosophy based on his own reason. In his *Discourse on Method* (1637), he argued that everything had to be proved, except basic ideas that were true beyond all doubt. For example, Descartes believed that the fact that he could think proved that he existed: "I think, therefore I am," he wrote. This was his first truth. From this basic truth, Descartes established a method of inquiry in which all thoughts would follow the clear, orderly progression of scientific reasoning.

Bacon. Descartes's contemporary, the English philosopher Francis Bacon, took a somewhat stronger line concerning how conclusions should be reached. Bacon rejected deducing knowledge from self-evident principles and instead argued that only through observation and repeatable experiments could theories be built. Bacon thus relied on proofs that could be demonstrated physically, not through deductive logic. He believed that the pursuit of scientific knowledge would enrich human life immeasurably.

Newton. In 1687 Isaac Newton published his *The Mathematical Principles of Natural Philosophy*. It combined and related the contributions of Copernicus, Kepler, and Galileo. These early scientists had shown that the planets, including Earth, revolve around the Sun. But they had not been able to explain why the planets moved as they did.

Newton's book contained his laws of motion and universal gravitation, which explained the movements of objects on Earth as well as of the planets. His law of universal gravitation states that all bodies attract each other with a force that can be measured. This force holds the whole system of sun and planets together by keeping them in their orbits.

Newton's work had a tremendous influence on the thinking of his own era and on all later scientific thought. The English poet Alexander Pope described Newton's impact: "Nature and Nature's laws lay hid in night; God said, 'Let Newton be!' and all was light."

Other scientific discoveries. New discoveries were made elsewhere in Europe. Working independently of each other, both Newton and Gottfried Wilhelm Leibniz (LAY-vihn), a German philosopher and mathematician, developed calculus, a branch of mathematics that studies continuously changing quantities. A Dutch scientist, Antoni van Leeuwenhoek (LAY-vee-uhn-hook), used the microscope, an invention of the late 1500s, to discover bacteria. The microscope enabled him to study a whole new world of life that could not normally be seen by the human eye.

Robert Hooke of England, who lived from 1635 to 1703, also worked with the microscope. The first person to identify cells in living matter, Hooke examined a thin slice of cork and noticed that it consisted of small rectangular "rooms." He called these "rooms" cells because they looked like the cells in which bees store their honey.

The Anglo-Irish scientist Robert Boyle is known as the founder of modern chemistry, the study of the
composition of materials and the changes they undergo. Another English chemist, Joseph Priestley, discovered the element later called oxygen. (Elements are the fundamental substances that make up matter.)

A French scientist, Antoine Lavoisier (lah-voh-see), named oxygen. Lavoisier showed that fire was not an element, as many had believed. He proved that fire was the result of the rapid combination of oxygen with another substance. Lavoisier also demonstrated that matter is indestructible; it can be changed from one form into another, but it cannot be created or destroyed. For example, when water boils, it does not disappear. It forms steam, which combines with the air. The water’s form has changed, but the water has not disappeared. Lavoisier’s discovery is known as the law of the conservation of matter.

By the time Priestley and Lavoisier made their discoveries, the scientific point of view dominated European thought. The people of the 1700s spoke of their changing times as an “Age of Enlightenment.”

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**Section 5 Review**

1. Define Scientific Revolution, scientific method, geocentric theory, heliocentric theory
2. Identify Nicolaus Copernicus, Galileo
3. Analyzing Ideas (a) Define “Scientific Revolution.” (b) Describe the factors that led to the birth of the Scientific Revolution.
4. Summarizing Ideas Explain how Copernicus, Kepler, and Galileo challenged traditionally held views and developed the heliocentric theory.
5. Interpreting Ideas Why were the ideas of Descartes, Bacon, and Newton significant to the scientific method?
6. Evaluating Ideas Choose three discoveries of the Renaissance and Reformation era and evaluate their importance.