

PRINTING TECHNOLOGY: EVOLUTION OR INVENTION?

GRADES: 9-12

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SUBJECT: World History

TIME REQUIRED: Three class periods

OBJECTIVES:

1. Help students evaluate the nature of technological development and its influence on world history.
2. Help students consider the roles of both independent invention and cultural diffusion in bringing about social change.
3. Encourage critical thinking by presenting students with contradictory evidence regarding the development of printing technology.

MATERIALS REQUIRED:

Handouts 1, 2, 3, 4, and 5 (attached)

BACKGROUND:

The development of print technology has certainly had a huge impact in the course of world history. It is widely believed in western countries that the main contributor to the print revolution was German inventor Johannes Gutenberg, author of the Gutenberg Bible. In this lesson, students evaluate Gutenberg's contributions in comparison to those of Koreans through the *Tripitaka Koreana* (a collection of woodblocks carved in Korea during the 13th century) and the *Chikchi* (a book written in moveable metallic that predates the Gutenberg Bible by 78 years). Students first consider the influence printing has had on human societies since the 13th century. Next they read, discuss, and evaluate five conflicting references that chronicle events of the 13th–15th centuries in Germany, China, and Korea. Finally, students discuss the concepts of independent invention and cultural diffusion in light of the readings.

PROCEDURE:

1. Give students Handout 1 and have them read it to themselves. (The article is from A&E's Biography site, and explains why the program chose Gutenberg as the most influential person of the Millennium (1000-2000). Discuss Gutenberg's contributions, and then steer the discussion toward the broader question of why the development of print technology was so important, and more specifically the influence of moveable metal type.
2. Give students Handouts 2, 3, and 5 and have them answer these questions as they read them:
 - What is the *Tripitaka Koreana*?
 - Why was it so important to Korean monks to protect the blocks?
 - What is the *Chikchi*?

- Compare the information in Handout 2 with the information about the Gutenberg Bible in Handout 1. How are the two books similar? Different?
3. Conduct a discussion that centers around these points:
- How do the documents conflict?
 - Why is Gutenberg so famous? How were his contributions different from those of Koreans?
 - Who, if anyone, deserves credit for inventing print technology?
 - What evidence do the handouts contain about the extent that Korean developments were culturally diffused?
4. Give students Handout 4. As they read it, have them answer these questions:
- Explain why the author claims that the technological roots of printing technology lie in China.
 - According to this author, what were Gutenberg's contributions to the development of printing technology?
 - Conduct a discussion that centers around these points:
 - How does this handout's description of printing history compare to the previous four handouts?
 - Why do you think Koreans were left out of the analysis?
 - Is technological development better explained as resulting from an evolutionary process or from individual invention?
 - Does any one person deserve credit for the invention of printing technology?

EVALUATION:

Students will write an in-class essay answering the final two questions stated above: Is technological development better explained as resulting from an evolutionary process or from individual invention? Does any one person deserve credit for the invention of printing technology?

HANDOUT 1

JOHANNES GUTENBERG

Printer: regarded as the inventor of movable-type mechanical printing in Europe. Born Johann Gensfleisch zur Laden zum Gutenberg, circa 1400, in Mainz, Germany. Little is known of Gutenberg's early life. The son of wealthy parents, he was probably apprenticed to a goldsmith and also learned the trade of gem cutting as a young man living in Mainz. Between 1428 and 1430, he moved to Strassburg (now Strasbourg, France) for political reasons, and would live there for almost 20 years.

It was in Strasbourg that Gutenberg most likely began the work that would eventually make him famous, though not in his lifetime, as the father of the printing press and one of the most influential people in the history of Western society. He realized that the traditional methods of handwriting manuscripts or even the early printing techniques of xylography (printing from woodcarvings) could not satisfy the great demand for printed material. For his method of mechanical printing, Gutenberg eventually combined features of such existing technologies as wine presses and textile and papermaking devices with a system of movable metal type, which consisted of over 300 characters. Each character was carved in soft metal, molded, and cast in a molten alloy of lead, antimony, and tin. This method of printing from movable type was used, without significant change, until the twentieth century.

It is not known exactly how far Gutenberg got in his work with movable type by the time he left Strasbourg. In late 1438, the heirs of one of his business partners sued him; they lost the suit, but the trial revealed that Gutenberg was working on a new invention, presumably the printing press that he clearly wanted to keep secret. By late 1448, Gutenberg was back in Mainz, where he borrowed money from a relative to continue his work. In 1450, he received a substantial loan from Johann Fust, a wealthy financier; Fust later loaned Gutenberg even more money.

Gutenberg most likely completed his printed masterpiece, the 42-Line Bible, by 1455 at the latest. The 42-Line Bible, like all of Gutenberg's typographic productions, was never attributed to him during his lifetime, but it later became known as the Gutenberg Bible. Many of the details of Gutenberg's work became known to historians through records of a lawsuit that Gutenberg lost against Fust and Peter Schöffer, a calligrapher and Fust's future son-in-law. Records of the case, dated November 6, 1455, indicated that Gutenberg was the designer of the press. Though it has been estimated that the sale of the Bible would have produced many times the necessary sum owed to Fust by Gutenberg, it was inexplicably not counted among the latter's assets at the trial.

The court awarded Fust control of the type for the Bible and for Gutenberg's other major work, a Psalter (the traditional English term for a book of psalms), as well as at least some of Gutenberg's other printing equipment. The first printed book in Europe to bear the name of its printer was a fine Psalter produced in August 1457 by Fust and Schöffer. Most historians agree that it was Gutenberg who had most likely developed the techniques used to produce the Psalter before he lost control of his equipment in November 1455. Strong evidence to support Gutenberg's claim to the invention of typography came not only from the trial records but also from Schöffer's son and Fust's grandson, Johann Schöffer, who wrote in 1505 "the admirable art of typography was invented by the ingenious Johannes Gutenberg at Mainz in 1450." (From

1509 on, Johann Schöffer became one of Gutenberg's chief detractors, however, claiming that his own father and grandfather were solely responsible for the invention.)

Gutenberg himself was forced to start over. He is believed to have produced at least several further works over the next decade, including the *Catholicon*, an encyclopedia. In January 1465, Gutenberg began receiving a pension from the archbishop of Mainz, including an annual measure of food and clothing and exemption from certain taxes. He died on February 3, 1468, and was buried in Mainz's Franciscan church.



HANDOUT 2

Pulcho Chikchi simch'e yojol

Pulcho Chikchi simch'e yojol (hereafter referred to as *Chikchi*) is the world's oldest text printed with metal type. Printed in 1377, it predates by 78 years the Gutenberg Bible of Germany, which was also added to the Documentary heritage list this year. *Chikchi*, currently in the possession of the National Library of France in Paris, was printed at Hungdok Temple in Ch'ongju, North Ch'ungch'ong Province, Korea. *Chikchi* is a collection of Buddhist treatises and teachings compiled by the ancient monk Paegun (1298-1374). It contains abstracts from the eulogies, songs, precepts and dialogues of great Buddhist monks and is intended for the instruction of Buddhist ascetics. They are the teachings that were needed to come to the core of Son (Zen) Buddhism. *Chikchi simch'e* is taken from Zen Buddhist teachings and means "teachings that point directly to the essence of the mind." This refers to the idea that when you meditate following the instructions provided by the Buddhas and the patriarchs of the Zen tradition you will come to know the mind of the Buddha and that your mind will likewise be enlightened. The *Chikchi* that has been handed down to the present is a book of Buddhist teachings printed with metal type.

One of the most impressive things about Korean culture during the Koryŏ dynasty (918-1392) was the development of printing and publishing, the representative example of which is the *Tripitaka Koreana*, a complete collection of the Buddhist scriptures carved on 80,000 wooden printing blocks that has already been designated a World Heritage. In 1234, the 21st year of the reign of King Kojong, metal type was invented and a text called *Sangjong kogum yemun* was printed. The invention of metal type predates the invention of the same in the West by some 200 years. But as the aforementioned book no longer exists, *Chikchi* printed in 1377, is recognized as the world's oldest book printed with metal type.

For several decades, there has been a movement in Korea to try to find other volumes of *Chikchi*. The copy of *Chikchi* that is in the National Library of France is the second of two volumes. But because it was printed in metal type, it is estimated that many must have been printed and judging by the fact that the *Chikchi* in France was taken there in early 1900, there are probably other copies of the book somewhere in Korea.

The search has centered on the records of old temples, libraries with big collections of antique books, and the collections of descendents of ancient scholars. The Printing Museum on the grounds of Hungdoksia Temple in Ch'ongju serves as the headquarters for the campaign. On December 3, 1999, a curator of the museum visited France to see the original *Chikchi*.

In the West, the book is known as *Chichi simgyong*. This name originates from the journal *Books* printed by the National Library of France in 1972. A year later, in a volume titled *Tresors d'Orient* published by the library, it was once again referred to by that name. There is a reason for this. Though the date is uncertain, when the book was in Korea, it was dismantled and the pages mounted on a board and then rebound. On the cover someone wrote with brush and ink *Chikchi simgyong*. The word *gyong* indicates that the book was considered the same as Buddhist scripture. However, the correct name is *Pulcho chikchi simch'e yojol*.

HANDOUT 3 THE TRIPITAKA KOREANA WOODBLOCKS

Haein Temple in North Kyongsang Province is home to two of the great treasures of world Buddhism: the *Tripitaka Koreana* wood blocks and the depositories in which they are stored. The 80,000 wood blocks used to print the *Tripitaka Koreana*, a classic collection of Buddhist teachings, sutras and rules, were carved in the thirteenth century to replace an earlier set which were lost in a fire during the Mongol invasion of Korea in 1232. The carving of the second set was undertaken in hopes of repelling future invasions. The project was launched in 1237 and completed in 1251.



Tripitaka Koreana

Buddhist scholars around the world recognize the Haein Temple *Tripitaka Koreana* wood blocks for their accuracy and quality. The *Tripitaka Koreana* is by far the most complete collection of Buddhist scriptures, laws and treatises extant today.



Approximately 320 Chinese characters are carved at evenly spaced intervals on both sides of each block. The wood blocks are carefully lacquered, and metallic strips cover the corners to prevent warping. They are housed in two long depositories on the temple grounds. The depositories, called Changgyong-gak, were specially designed to provide natural ventilation and modulate temperature and humidity. The earthen floors are covered with a layer of porous charcoal, which naturally regulates humidity within the building. As a result, the wood blocks have endured more than seven centuries.

Reference:

“Cultural Heritage: Tripitaka Koreana,” http://whc.unesco.org/pg.cfm?cid=31&id_site=737

HANDOUT 4 PRINTING: HISTORY AND DEVELOPMENT

China: The Technological Roots

The invention of the printing press depended on the invention and refinement of paper in China over several centuries. The Chinese had developed "rag" paper, a cheap cloth-scrap and plant-fiber substitute for cumbersome bark and bamboo strips and for precious silk paper, by 105 CE. Chinese prisoners passed a mature technology on to their Arab captors in the eighth century. The secrets of the craft that were revealed to Europeans in the twelfth and thirteenth centuries were substantially the same techniques the Chinese had passed to the Arabs several centuries earlier.

Long before the Gutenberg press, Chinese innovations in ink, block printing and movable clay type all fed the technological push toward expanding the written word's range of influence. Although the European innovations came much later, European culture certainly felt the impact of print more dramatically than the Chinese did. Because their alphabet employs thousands of visually specific ideograms, the use of movable type was much more labor-intensive for the Chinese. Consequently, it did not change production efficiency as dramatically as it did for Europeans. Some historians will also assert that the sequential, linear and standardized character of the printed word especially suited Western impulses toward progress and conquest-- a disposition that favors quick and intense change.

Gutenberg and the Historical Moment in Western Europe

In the early 1450s rapid cultural change in Europe fueled a growing need for the rapid and cheap production of written documents. Johannes Gutenberg, a goldsmith and businessman from the mining town of Mainz in southern Germany, borrowed money to develop a technology that could address this serious economic bottleneck. From its European debut in the 12th century, paper gradually proved to be a viable alternative to the animal-skin vellum and parchment that had been the standard means of carrying written communication. Rag paper became increasingly cheap and plentiful while literacy expanded; the two processes accelerated, in part, by stimulating each other. The need for documentation continued to increase with expansions in trade and in governmental scope and complexity. Scribal monks sanctioned by the Church had overseen the maintenance and hand copying of sacred texts for centuries, but the secular world began to foster its own version of the scribal copyist profession. The many new *scriptoria*, or writing shops, that sprang up employed virtually every literate cleric who wanted work.

Gutenberg foresaw enormous profit-making potential for a printing press that used movable metal type. Despite their rapid growth in numbers, secular scribes simply could not keep up with the commercial demand for books. Gutenberg also saw strong market potential in selling indulgences, the slips of paper offering written dispensation from sin that the Church sold to fund crusades, new buildings and other projects devoted to expanding its dominance. In fact, press runs of 200,000 indulgences at a time were common soon after the handwritten versions became obsolete.

Gutenberg developed his press by combining features of existing technologies: textile, papermaking and wine presses. Perhaps his most significant innovation, however, was the efficient molding and casting of movable metal type. Each letter was carved into the end of a steel punch, which was then hammered into a copper blank. The copper impression was inserted into a mold and a molten alloy made of lead, antimony and bismuth was poured in. The alloy cooled quickly and the resulting reverse image of the letter attached to a lead base could be handled in minutes. The width of the lead base varied according to the letter's size (for example, the base of an "i" would not be nearly as wide as the base of a "w"). This emphasized the visual impact of words and clusters of words rather than evenly spaced letters. This principle lent an aesthetic elegance and sophistication to what seemed to many to be the magically perfect regularity of a printed page. Gutenberg designed a Latin print Bible which became his signature work. He launched a run of some 300 two-volume Gutenberg Bibles, which sold for 30 florins each, or about three years of a clerk's wage. Despite the dramatic success of his invention, Gutenberg managed to default on a loan and lost his whole printing establishment. His techniques were made public and his creditor won the rights to the proceeds from the Gutenberg Bibles.

The clergy were eager to take advantage of the power of print. Printed indulgences, theological texts, even how-to manuals for conducting inquisitions became common tools for the spread of the Church's influence. But the Church had even more difficulty controlling the activities of printers than they had with the secular scribes. The production and distribution of an expanding variety of texts quickly became too widespread to contain. Printed copies of Martin Luther's theses, for example, were widely and rapidly disseminated. They prompted far-reaching discussions that became the foundation for mounting opposition to the Church's role as the sole custodian of spiritual truth. Bibles printed in vernacular languages rather than Latin fueled the Protestant Reformation based on the assertion that there was no need for the Church to interpret scripture--an individual's relationship with God could be, at least in theory, direct and personal.

In 1476, William Caxton set up England's first printing press. Caxton had been a prolific translator and found the printing press to be a marvelous way to amplify his mission of promoting popular literature. Caxton printed and distributed a variety of widely appealing narrative titles including the first popular edition of Chaucer's The Canterbury Tales. Caxton was an enthusiastic editor and he determined the diction, spelling and usage for all the books he printed. He realized that English suffered from so much regional variation that many people couldn't communicate with others from their own country. Caxton's contributions as an editor and printer won him a good portion of the credit for standardizing the English language.

HANDOUT 5

Depositories of *Tripitaka Koreana* Woodblocks at Haein Temple

Haein-sa, the Temple of the Ocean Seal Meditation, is nestled partway up Mt. Kaya, Hapch'on County, South Kyongsang Province. King Aejang of Silla built it for the monks Sunung and Ijong built it in his third year (802). The founder of the Koryŏ kingdom, King T'aejo, designated it as a state temple. Today it has 75 subordinate temples and 14 hermitages scattered nearby.

When the nation was imperiled by the Mongolian invasion at the end of the Koryŏ kingdom, King Kojong, who had taken refuge on Kanghwa Island in 1230, initiated the laborious carving of the *Tripitaka Koreana* woodblocks, hoping to repel the barbarians with the help of the divine providence of Buddha. The project took 16 years, from 1236 to 1251. The *Tripitaka Koreana* woodblocks are testimony to the pious devotion of both king and people. They were first housed in Sonwon Temple on Kanghwa Island, moved to Chich'on Temple in the 7th year (1398) of King T'aejo of the Chosŏn kingdom, and the next year moved again to Haein Temple, making it a religious cradle for national peace and prosperity from that time on.

In the temple compound are two main depositories and two small depositories. Of the two main depositories, the one on the south is Sudara-jang, the Hall of Sutras, and the one on the north Poppo-jon, the Hall of Dharma Treasure. Each measures 15 *kan* (1 *kan* is about 6 feet) across the front and 2 *kan* on the side. They were designed to optimize the preservation of woodblocks with the proper ventilation, temperature, and humidity by taking the best advantage of natural conditions and scientific architecture. Thus the woodblocks have been kept in impeccable condition, which enabled the depositories to win registration on UNESCO's World Cultural Heritage List in December of 1995.

Tripitaka is a Sanskrit word made up of *tri*, "three," and *pitaka*, or "baskets," referring to the *kyong* (sutras, scriptures) *yul* (monastic rules) and *non* (treatises) which respectively are discourses with the Buddha, the Buddhist laws of ascetic life, and commentaries on the sutras by eminent monks and scholars. Known in Korean as *P'alman taejanggyong* (Great Collection of Buddhist Scriptures in Eighty Thousand Woodblocks), the *Tripitaka Koreana* consists of 81,258 woodblocks. Amazingly, there is no trace of errors or omissions on any woodblock. To guard against insects, decay, frame distortion, cracks, and humidity, the material of the woodblocks was treated for years by a special process. In terms of accuracy, beauty of font style, carving skill, and volume, the *Tripitaka Koreana* is recognized as the most valuable existing Buddhist canon carved in Chinese characters. It has been a jewel for the Japanese, who modeled their *Taisho shinshu daizokyo* (Newly revised edition of the Buddhist Canon printed in the Taisho era) after the Korean edition. The Chinese also imported copies of the Korean edition.