

Developed by James R. Kiamie**Grade Level:** 9-12**Topic:** Historical development of astronomy in Korea during and after the reign of King Sejong**Essential Question:** What significant advances in the study of astronomy were made in Korea during and after the reign of its greatest king in history?**Standard/s):**

- NJCCCS 5.4 Earth Systems Science: All students will understand that Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.
- NJCCCS 6.2: World History: Global Studies: All students will acquire the knowledge and skills to think analytically and systematically about how past interactions of people, cultures, and the environment affect issues across time and cultures. Such knowledge and skills enable students to make informed decisions as socially and ethically responsible world citizens in the 21st century.

Learning objective(s):

- SWBAT identify several examples of astronomical instruments developed in Korea during the reign of King Sejong.
- SWBAT describe the detailed operation of at least one device utilized to make astronomical measurements in Korea and analyze its functioning based upon features depicted in its illustration.

Assessment(s): (Attach assessment tools & rubrics)

See homework assignment

Materials:

- *In the space provided below, list the materials that will be necessary to complete this lesson. Include any sources, supplies, and multimedia that will be used.*
- Handouts #1 - #4 with illustrations of astronomical instruments utilized throughout Korean history (**Appendices E, F, G and H**)
- Video clip: King Sejong the Great: <https://www.youtube.com/watch?v=8IUkerZD0XQ>
- Whiteboard/chalkboard
- Books:
 - *King Sejong the Great: The Everlasting Light of Korea, Korean Spirit & Culture Promotion Project* (2008): Available at http://www.koreanhero.net/kingsejong/content/en/King_Sejong_en.pdf
 - *Fifty Wonders of Korea: Volume 2. Science and Technology, Korean Spirit & Culture Promotion Project* (2008): Available at: http://www.koreanhero.net/fiftywonders/FiftyWonders2_English.pdf
 - Jeon, S-W. (2011). *A History of Korean Science and Technology*, NUS Press.
 - Needham, J., et. al. (2004). *The Hall of Heavenly Records: Korean Astronomical Instruments and Clocks 1380 – 1780*, Cambridge University Press

Student prior knowledge needed:

- Ability to identify Korea (contemporary South Korea and North Korea) as a nation in Asia
- Basic understanding of the fundamental components of the solar system
- Recognition of astronomy as an independent scientific discipline
- Appreciation of the important role of instrumentation in the process of scientific discovery

Time	Lesson Sequence
6 min.	<p>Engage:</p> <p>Students will briefly answer the following questions on a blank sheet of paper:</p> <ol style="list-style-type: none"> 1. List two goals of astronomy 2. On which continent is South Korea located? 3. Identify two useful tools that can be employed by astronomers in their work 4. Watch the video about King Sejong: https://www.youtube.com/watch?v=8IUkerZDOXQ
3 min. 15 min.	<p>Main Activity</p> <p>Teacher will briefly review student responses to the DO NOW activity with the whole class.</p> <p>Teacher will present information regarding Korean astronomical achievements realized during the reign of King Sejong. Delivery can be accomplished via lecture and chalkboard notes if a functioning SMART Board is not available.</p> <ul style="list-style-type: none"> • King Sejong ruled Korea from 1418 to 1450 (See Appendix A for a portrait of King Sejong the Great) • In 1432, King Sejong recognized the need for a new almanac and commissioned two scholars to investigate the use of <i>Kanui</i> devices, which allowed for astronomical measurements in three sets of coordinates: horizontal, equatorial, and ecliptic (Appendix B). His goal was to determine the latitude of the city of Seoul, the capital. • In 1434, a huge observatory was built on the grounds of the Royal Palace. To the west were stone pillars overlaid with copper. Marks for units of measurements were inscribed on a stone and used to measure the lengths of shadows cast by the pillars. • Four different sundials having varying shapes and functions were developed. The most famous of these was the <i>Angbu Ilgu</i> or cauldron-sundial (Appendix C). This device was unique to Korea and was built in a

hemisphere with lines drawn inside to measure the time of day. The gnomon, a raised arm attached to one side of the surface, indicated time by its shadow. In order to make the sundial accessible to people who were illiterate, animal symbols for each hour were drawn on the dial's surface.

- King Sejong also ordered technicians to make the *Ilson Chongsiui*, which was capable of keeping time during all hours of the day and night. Four of these clocks were made; one was placed in the Hall of Heavenly Records, one was installed in Manchun Hall, and the other two were placed in border regions.
- In 1434, the water clock *Chagyongnu*, was invented by Chang Yong-sil ([Appendix D](#)). It had the capacity to display and to announce the time to people nearby. Bells, cymbals, and drums would sound according to the passing of the traditional Asian time units si, kyong, and chom and a mechanical doll would emerge to tell the time.
- According to the Sejong Sillok, the *Chagyongnu* “contained four water containers of varying sizes filled with water and two containers into which the water flowed. As the water levels rose in the latter containers, a spring device was triggered, causing an iron ball to be released, which would in turn activate the sound mechanism. A bell would ring to represent the passing of si [a unit of time equal to 1/12th of a day], a drum would sound for kyong [a unit equal to 1/5th of period between 7 pm and 5 am] and a cymbal for the chom [equivalent to one hour].”
- Okru, another water clock having greater precision, was built and housed next to the King's chambers.
- King Sejong also dispatched scholars to various mountains in Korea in order to observe solar eclipses. Researchers from the Hall of Heavenly Records were sent to calculate the latitude of the North Star. A total of 19 solar eclipses were observed and recorded, 12 eclipses of planets by the moon, 13 eclipses of fixed stars by planets, two approaches and overlaps of planets, 14 appearances of novas and comets, 359 coronas of the sun and white rainbows, 30 shooting stars, and 66 stars seen during the day.
- When an irregularity such as an eclipse occurred, the King held a ceremony called the *Kusikrae* that signified his obedience to Heaven's will and his pledge to rule with caution and wisdom. In order to prepare for the ceremony, the King was warned of an eclipse at least three months in advance based upon observed changes

10 min.	<p>in the behavior of stars and planets. It was required that eclipse forecasts be accurate to the minute and second.</p> <ul style="list-style-type: none"> In 1442, <u>Chiljongsan</u> (A Calculation of the Motions of the Seven Celestial Determinants; the Sun and Moon, Mercury, Mars, Jupiter, Venus, and Saturn) was published in two volumes. The first volume was a revision of existing Chinese almanacs with the point of reference changed to Seoul. It allowed scientists to calculate the positions of all planets with respect to Seoul as well as the times and occurrences of solar and lunar eclipses. The second volume utilized new standards for circumference and time measurements. <p>Students will divide into their cooperative learning groups, discuss the following issues concerning developments in astronomical study under King Sejong, and record notes based upon their conversations:</p> <ul style="list-style-type: none"> Which of the King's achievements was most significant and why? What types of knowledge must his scholars and technicians have possessed in order to construct and subsequently employ the identified astronomical instruments? Why did King Sejong give such priority to advancing his nation's astronomical capabilities?
2 min.	<p>Review and Assessment:</p> <p>Teacher will lead a class discussion of selected points shared by students from their group conversations.</p>
2 min.	<p>Wrap-up:</p> <p>Teacher will lead a class discussion of two pieces of information learned by students in the lesson.</p>
2 min.	<p>Teacher will distribute the handout and briefly discuss it with the whole class.</p>

Homework:

1. List five conclusions concerning Korean astronomical heritage that arise from your group discussion in class; and
2. a) Conduct Internet research on one of the astronomical instruments illustrated in the handout and
b) Write a three-paragraph essay that:
 - i) describes the time period and social context in which the instrument was utilized;
 - ii) analyzes the detailed operation of the instrument based upon functional features depicted in the illustration; and
 - iii) evaluates the significance of the instrument as a precursor to subsequent technology.

Appendix A

Kind Sejong the Great



Source: <http://korea.prkorea.com/wordpress/english/files/2012/06/sejong.jpg>

Appendix B

Model of astronomical instrument “Kanui” at the royal tomb of King Sejong



Source: <http://londonkoreanlinks.net/wp-content/uploads/2011/04/Astronomy-5.png>

Appendix C

Sundial "Angu Ilgu"



Source: http://en.wikipedia.org/wiki/Jang_Yeong-sil#/media/File:Seoul-Gyeongbokgung-Sundial-02.jpg

Appendix D

Automated Water Clock "*Chagyongnu*"



Source: http://www.koreanhero.net/kingsejong/content/en/King_Sejong_en.pdf (pg. 75)

Appendix E: Hand out #1

Chomsongdae in Kyungju

Height 9.5 m, built around AD 632, National Treasure No 31.

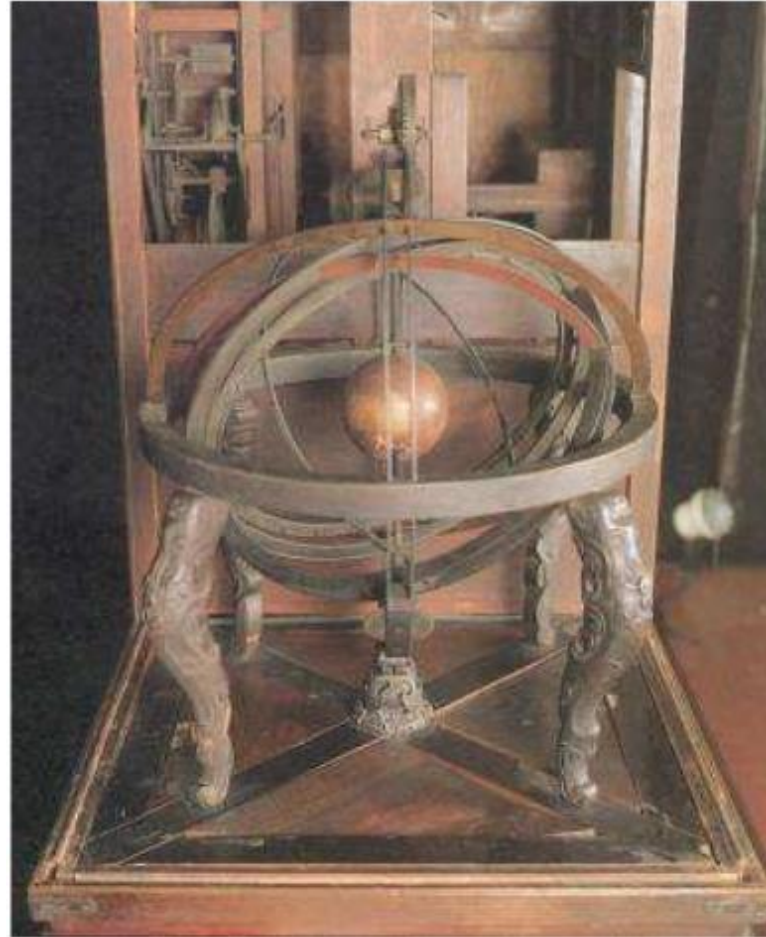


Source: <http://londonkoreanlinks.net/wp-content/uploads/2011/04/Chomsongdae-373x500.png>

Appendix F: Hand out #2

The Astronomical Clock

Built by Song Yi-Yong in 1669, National Treasure No. 230, Korea University Museum



Appendix G: Hand out #3

Model of armillary sphere “Honcheonui” at the royal tomb of King Sejong



Source: <http://londonkoreanlinks.net/wp-content/uploads/2012/02/Honcheonui.jpg>

Appendix H: Hand-out #4

A bronze mirror of the Middle Koryo period, symbolizing the various divisions of the northern celestial hemisphere



From the centre: a knob representing the *axis mundi* at the north pole; the four directional animal symbols; the eight trigrams; the twelve animal symbols of the Earthly Branches, representing the Jupiter Stations; the twenty-eight Lunar Lodges and the twenty-four Fortnightly Periods.

Source: Needham, J., et. al. (2004). *The Hall of Heavenly Records: Korean Astronomical Instruments and Clocks 1380 – 1780*, pg 5