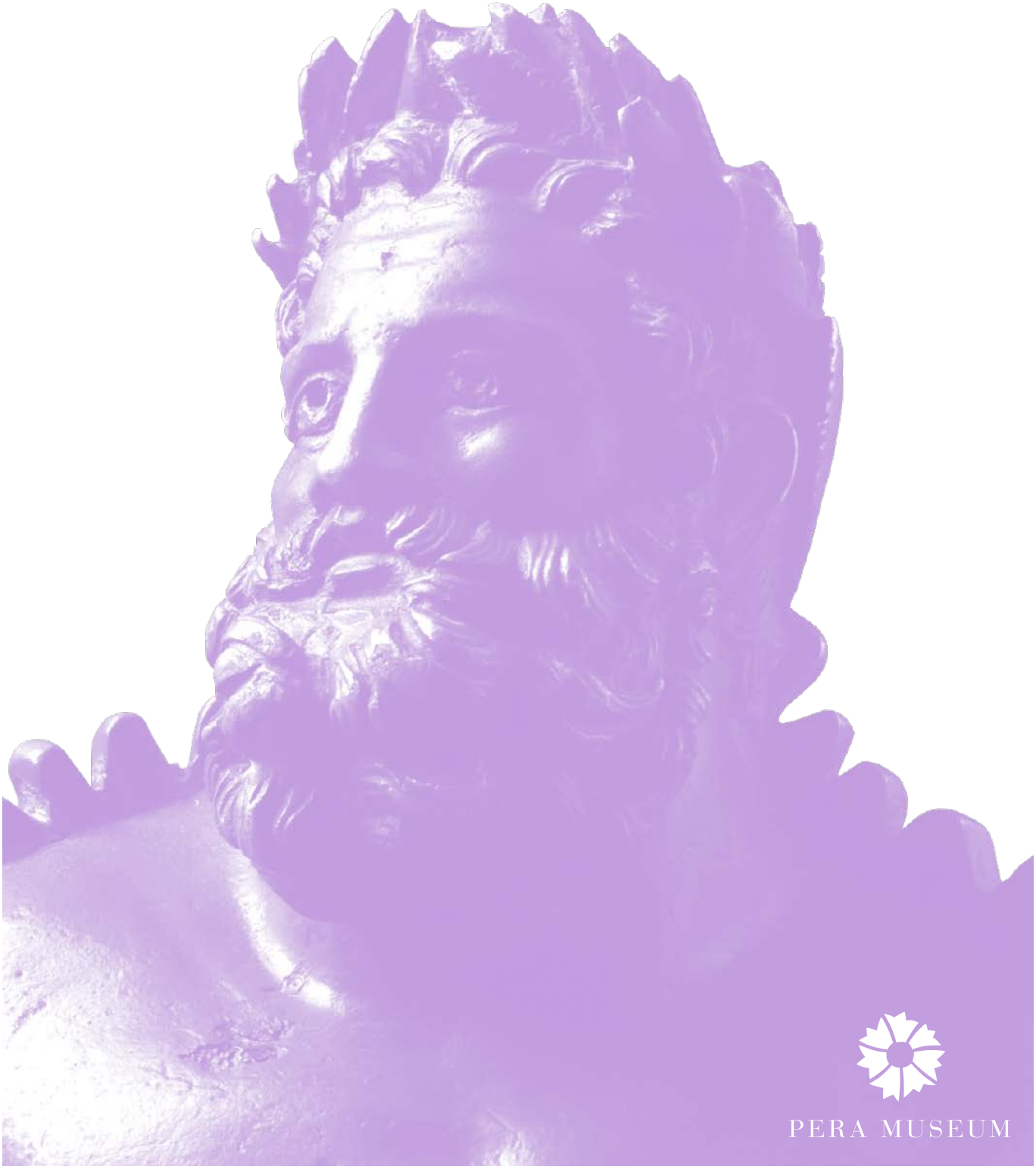
TEACHERS' GUIDEBOOK

Anatolian Weights and Measures Collection
The Art of Weights and Measures Exhibition



PERA MUSEUM

Dear Teachers,

Suna and İnan Kıraç Foundation Pera Museum expands its programs with online events. Pera Learning Programs came up with Teacher Guidance Booklets as part of the collection's exhibitions.

Teachers can visit and teach using online 3D exhibitions. The booklets include descriptions of selected works, suggested activities and questions for students related to exhibitions such as Orientalist Painting Collection - Intersecting Worlds: Ambassadors and Painters, Kütahya Tiles and Ceramics Collection - Coffee Break as well as Anatolian Weights And Measures. Teachers can use these booklets to prepare ahead of their visit to the museum with student groups, gain insight into how to examine the pieces. With the provided information students develop critical and creative thinking, inquiry and accurate self-expression skills. Following the online museum trip, teachers may do various activities back at school about the exhibitions.

For digital exhibitions, please visit: https://www.peramuzesi.org.tr/sergi/dijital-sergiler

For more information: ogrenme@peramuzesi.org.tr

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About Pera Learning

Pera Museum Learning Programs' workshops, which include hands-on activities, aim to bring the museum into social life. Pera Learning continues to hold uniquely colorful and creative events organized under the Pera Kids (4-6, 7-12), Pera Young (13-17), Pera+ (18+, 60+), Teachers, School Groups (kindergarten, primary school, middle school, high school) and Pera Enabled (Mentally Disabled) categories with programs, collection exhibition- and temporary exhibition-themed workshops designed for this purpose.

Participants with any level of experience can explore different aspects of museology through workshops focusing on different artistic movements. At the same time, the participants enjoy an immersive exploratory experience through sight, touch and smell. Pera Learning also organizes Virtual Reality, Maker, 3D Design, Minecraft and IoT workshops, which are highly popular among children and young people. Using creative drama methods such as role-playing and improvisation and gamification, the program features activities that enable visitors to experience the museum as a living space, become more aware about what a museum is and improve their aesthetic skills.

Pera Learning's annual program also offers workshops designed for special occasions. Creative drama, body percussion and storytelling activities, Children's Chamber Orchestra and Children's Choir events are organized for children on April 23 National Sovereignty and Children's Day. Young people can enjoy interesting workshops such as hip-hop dance workshops and mask workshops free of charge on May 19 Commemoration of Atatürk, Youth and Sports Day. Pera Learning also organizes various other workshops such as Semester Break Workshops, Mother's Day, Father's Day, Summer Vacation Workshops and Special New Year's Workshops.

At Pera+ workshops, which can be attended by anyone aged 18 and over, participants enjoy an expert guided tour of Pera Museum's collections and temporary exhibitions and have a multidisciplinary museum experience encompassing philosophy, music, literature and photography. Pera Learning organizes exhibition tours and interdisciplinary workshops for teachers from various fields of study as part of its collection exhibitions. These workshops offer teachers information on how to give their students a more effective and interactive museum tour. Pera Learning also holds group exhibitions in the summer, featuring the creative works by children who attended the temporary exhibition-themed summer workshops. The exhibition consisting of objects created by children during the summer workshop program can be visited at the workshop area and online.

We invite everyone to Pera Museum to express themselves through art and design in this wide variety of workshops organized as part of our Learning Programs.

Suna and İnan Kıraç Foundation Anatolian Weights and Measures
1st Floor Exhibition Hall

The Anatolian Weights and Measures Collection is one of the three main collections of the Suna and Inan Kıraç Foundation.

The collection includes all the prominent weights and measurement instruments used in Anatolia for nearly four thousand years, since the second millennium B.C. and it is regarded as one of the leading collections in the field. It includes weighing and measuring tools used in a variety of fields, from land measurement to commerce, and by various professionals, including architects, moneychangers, mariners and pharmacists. It acts as a scientific resource that illustrates the systematic relations between periods and cultures and allows us to observe the transformations and continuities over time. This exhibition hosts a broad selection from the collection in chronological order, shedding light on this exciting aspect of the Anatolian history of science and culture and offering a fresh look at the long history of commercial practices based on weights and measures.

Useful Information
•The collection began in the 1980s.
•There are over 10,000 artifacts in the collection.

What is the significance of this exhibition?
•It is the only collection in Turkey and in the world where such a high number and variety of weights and measures are presented together.

Concepts on weights and measures
•Weight: It is the gravitational force of an object, measured in Newtons.
•Measure: It is the evaluation of the quantity of something by scaling it to the unit used for that object. This kind of evaluation uses the measurement units of meter, liter and kilogram.

Length standards
•The first length standards were created by using human body parts, such as the thickness of a hand, the width of a hand, hand span or foot length.
•In 3000 B.C., Pharaoh's elbow was a common standard.
•In 1101 A.D.., the distance between the nose and the index finger of King Henry I was used as a standard.

The Metric system
•As the world engaged in more trade and people came across different weighing and measuring systems, conducting business became difficult.
•Scientists argued for 193 years (1790-1983) to find a common system that could be used by the whole world.
•Finally, they agreed on the "metric system".

Units
•Length: Meter (The basic unit for length is the meter. You can measure the length of a person, a tree or a door using the meter.)
•Mass: Gram
•Volume: Liter (Liter is the unit used for measuring the volume of a liquid.)

Art of Weights and Measures
Anatolian Weight and Measures Collection

Setting forth concepts related to weighing and measuring meant developing both practical and philosophical links with the world. When ancient civilizations used seeds produced in the fertile soils of Mesopotamia to establish the first units of weight, the observations they made in relation to the act of measuring created a springboard for civilizations to thrive. The 2nd millennium B.C. saw the frontiers of discovery advancing along the trade routes between Mesopotamia and Anatolia.

While the fascination with precision in weighing and measuring continued, there was a corresponding migration of myths from the realms of the gods to the land of the mortals, and concepts like truth and justice became associated with the balancing of the suspended pans of weighing scales. In ancient Egypt the sins of the deceased were weighed on a set of scales, while in ancient Greek and Roman cultures, the weighing scale was a symbol of justice and an indispensable illustrative element in the depiction of gods and goddesses. In Byzantine society, too, the act of just and accurate weighing resonated deeply with ethical sensibilities and recalled the weighing of souls. And in the Ottoman Empire, precise weighing represented the foundations of trust, not only in trade but also just as notably in religious life.

“Man is the measure of all things: of the things that are, that they are, of the things that are not, that they are not,” proclaimed Protagoras. The endeavor to measure the world with a handful of units brought forth the capacity to recreate it in the abstract. As the measurement of discovery became the substance of myths, weighing and measuring, beyond being mere physical actions, became an important means of self-expression to those captivated by the universe and what lay beyond the boundaries of knowledge.

With a selection of objects from the *Suna and İnan Kıraç Foundation Anatolian Weights and Measures Collection*, the Art of Weights and Measures exhibition aims to explore, through the eyes of civilizations, gods, merchants, master craftsmen, and their apprentices from the 2nd millennium B.C. to the present day, how weights and measures have shaped economies, cultures, and intercultural relations, their impact on social dynamics of trust, and their journey towards becoming standardized units.

2nd-1st Millennium BC
Stone (Hematite)

Sleeping Duck

Used frequently in Mesopotamia and known as the Babylonian type, these weights are in the shape of a stylized duck with its head turned backwards and pressed against the body. A horizontal hole can be found at the intersection of the neck and the head. The head and tail details are engraved. Typically made from hematite, as well as white and cream-colored quartz, these weights often bear motifs engraved on the undersides, which are thought to be marks identifying the owner. Very similar weights have been found in the Near East, where they are known to belong to the system of weights used in the Old Babylonian period (2004-1595 B.C.) in Mesopotamia, and therefore must have been introduced into Anatolia by Assyrian merchants.

Similar weights have also been found at other sites in Anatolia and were probably produced as the equivalents of units of weights like the mana and shekel, which were used in the countries of the Near East during this period. These weights can also be found in the shape of a bull's head, frog's head, and bird while some are made of bronze.

Questions
1.What animal does this artifact look like?
2.What does the sleeping duck measure?
3.Does it look like the weighing tools we use today?
4.What material is it made of?

Answers
1.Sleeping Duck.
2.Mass.
3.Today, we typically use electronic scales. As people spent more time in nature during those periods, their creations were inspired by animal figures.
4.Stone

Steelyard Weight in the Form of
a Bust of Heracles
2nd Century A.D. 3,785 g

Steelyard Weight

The steelyard weight in the form of a bust of Heracles, a symbol of strength and courage, is one of the most important artifacts of the Suna and İnan Kıraç Foundation's Anatolian Weights and Measures Collection. Depicted with a long, prominent beard, Heracles wears a wreath of laurels on his head. It is believed that the whites of his eyes were previously fashioned from silver, and the pupils, now only hollows, were once decorated with precious stones. Only four centimeters of the weave-shaped original chain remain on the affixed ring placed on the crown of his head.

Questions

1.What kind of character does this weight represent?
2.Who is on the bust?
3.What material is it of?
4.What was it used for?

Answers

1.It represents one of the best-known heroes of Ancient History, a symbol of power and courage.
2.Heracles (Greek God)
3.Bronze.
4.It was used as a steelyard weight.

Balance

Brass Balance. 19th- 20th centuries

Known as the Roberval balance, this device uses plates placed on the weighing platform. The mechanism was invented by the French mathematician Gilles Personne de Roberval.

Questions

1.What is a balance?
2.Do we still use such balances today? Please discuss the differences.
3.How do you use these types of balances?
4.What does the balance represent?

Answers

1.It is a device that measures the mass of an object using the influence of gravity.
2.We use electronic scales.
3.This device uses the principle of balancing and measures mass. On one side, we place objects whose mass is already known, and on the other side, we place objects that we wish to measure and try to balance them. This is called weighing.
4.This device represents balance and justice.

Steelyard

Steelyard (Ottoman Period)
Late 19th century-Early 20th century
28.5 cm

Two or three faces of the arm are graduated with notches at equal intervals, using a specific unit system. The mass of the object is measured by sliding the steelyard weight on the arm, enabling light, medium and heavy loads to be weighed at the same time.

Questions

1.Does anyone know the name of this artifact?
2.How do you think a steelyard was used?
3.What is made of?

Answers

1.Steelyard
2.Compared to a balance, a steelyard can easily weigh heavier commodities. The steelyard consists of a square-section arm fitted with a sliding weight, and a chain with a hook for hanging the object to be weighed.
3.Iron and brass.

Quadrant

Quadrant, 1860

Signed "Osman", this quadrant was made to be used on the 41st parallel, on which Istanbul lies, to determine the time and the direction of the *qibla*. Devices including the astrolabe, quadrant and the *qiblanuma* (*qibla* compasses) were first invented in the Middle Ages, for the same purpose. Inspired by the astrolabe used in astronomy and time measurement, the quadrant was used not only by horologes for determining prayer times and the *qibla* direction of mosques but also by architects for measuring angle, height, and inclination.

In astronomic measurements, the quadrant was designed to be used with one specific latitude and would only provide accurate information for the settlement on that latitude. The front of the quadrant was used to calculate the angle of the sun and had projection markings that can be used at that specific latitude. The back of the device served as a calculator for calculating the spherical trigonometric functions between celestial objects and performing other algebraic or arithmetic operations. Often made of boxwood or similarly firm woods, quadrants were commonly used in Islamic countries until the early 20th century.

Questions

1.What is Astronomy? Have you ever heard of the word 'astronomy'? What does it mean?
2.Have you ever seen a shooting star in the sky?
3.Can anyone guess the name of this device?
4.What period can this artifact be from?
5.What do you think this artifact was used for? What do we use today for the same purpose?
6.What material is the quadrant made of?

Answers

1.Astronomy is the science of the Universe. It studies all observable phenomena that take place outside of the Earth's atmosphere, including the stars, planets, comets, auroras and galaxies.
2.Yes / No.
3.Quadrant.
4.Middle Ages.
5.Created for astronomical measurements and time measurements, the quadrant was used by horologes for determining prayer times and the *qibla* direction of mosques, as well as by architects for measuring angle, height, and inclination. The quadrant was designed to be used with one specific latitude and could only provide accurate information for the settlement on that latitude. The front of the device was used to calculate the angle of the sun and had projection markings able to be used at that specific latitude. The back of the device served as a calculator for calculating the spherical trigonometric functions between celestial objects and for performing other algebraic or arithmetic operations.
6.Boxwood or a similar type of hard wood.

Havayi Terazi (Miner's Triangle)

Miner's Triange, Brass, 100 x 117 mm

It is known that Sinan the Architect used a *havayi terazi* in the construction of the Kırkçeşme water supply network. The instrument was employed in Europe until the 19th century and came to be known as the miner's triangle, as it determined gradients in mines.

Questions

1.What geometrical shape does the tool look like?
2.What do you think this artifact was used for?
3.When and why do you think it might have been used for the first time?
4.What could it be made of?

Answers

1.An equilateral triangle.
2.It was commonly used for measuring elevation in the construction of the aqueducts and watercourses. One of the sides of the triangle features two hooks equidistant from the two corners. A plumb line with a plumb-bob on the other end is connected to the center of the same side as the hooks. The opposite corner, on the other hand, features a short line that divides the triangle into two equal parts.
3.It was first encountered in Iraq in the 11th century and Roman Imperial period (1st century B.C.- 3rd century A.D.) .
4.Brass or bronze.

Other Objects in the Exhibition

Sleeping Duck Shaped Stone Weight (1/2 shekel), 2000-1000 BC,
Stone, 5.50g, 24 x 12 x 15 mm

Shekel: It was one of the weight units used in Mesopotamia, Palestine and Anatolia. A *shekel*'s weight equaled 180 pieces of barley.

Lead Weight, Cyzicus, Hellenistic-Early Roman Period, 43.60 g, 35 x 33 x 5 mm)

Mina: In the basic weight system in Mesopotamia, Palestine and Anatolia, 1 *talent* equaled 60 *minas*, and 1 *mina*, 60 *shekels*. One *shekel* weighed 180 pieces of barley. *Mina* formed the basis of many weight units and the metric system, and it is roughly equivalent to 500 grams.

Roman Imperial Period, AD 1st-3rd centuries
Bronze-lead, inlay in silver
Dimensions variable

Knuckle Bone: Knuckle bones were used for telling fortunes and as game tokens in the Roman times, and they were also made into weights using bronze, lead or glass. Although all mammals have an astragalus or knuckle bone, only those in sheep, goat, pigs, cows or deer have the right cubic and circular shape that allow them to be used as dice. Thanks to this unique shape, the knuckle bone is considered the original dice.

These astragal-shaped weights which form a set of three with a handle on top reveal an elaborate craftsmanship. The Romans introduced their own system of weights based on the libra to Anatolia. The denominational marks written in Latin and Greek indicate the numbers which correspond to their mass. According to the Roman system, one libra was equivalent to 12 unciae (libra of 327.45 g).

The astragalus is the talus bone in the heel of many mammals that has a rounded but cubiform shape. With its attractive shape, astragalus has been an inspiration for both secular and spiritual objects throughout history. Having been used as game dice in Ancient Greek and Roman cultures, it was also assigned to magical attributions.

Astragalus-shaped objects can be found in bronze, lead, and glass as well as in other different materials.

Steelyard Weight in the Form of Athena Roman Imperial Period

Steelyard Weight: The steelyard consists of a square-section arm fitted with a sliding weight and hooks for hanging the object to be weighed. Two or three faces of the arm are graduated with notches at equal intervals, using a specific unit system. Many of the busts and statuettes that were used as steelyard weights in Eastern Mediterranean countries were made and used in this region, whereas the weights that are displayed in museums around the world state that they were made in Constantinople or nearby regions.

Steelyard weights, which played an important role in the Roman and Byzantine trade system, were made in both descriptive and non-descriptive shapes (sphere, pear, or bell shapes). In the Byzantian times, using the imagery of the emperor, empress or Minerva (Athena) was common. It is thought that using the image of the gods, goddesses and the emperor would create trust for the customer and indicate that the trade was done accurately and fairly.

In the Roman period, the steelyard weights typically were made into spheres, polygonal prisms, busts or statuettes. Bronze steelyards in various sizes and weights were preferred by many merchants and dealers in many countries, as they were easy to carry. These bronze weights, which were given shape through lost-wax casting, were filled in with the desired amount of lead.

Glass coins from different time periods

Glass Weights: Before the Islamic glass weights, called *sanja*, the Byzantines also used glass weights. The most common glass weights included those with a bust of the governor (*Eparkhos*) or the emperor and an inscription around it, or weights that were stamped with a box/block, or a monogram with a cross.

In the weights bearing the governor, *Eparkhos* is depicted holding a linen napkin called *mappa*, or a scepter, or both, to start the arena games. In the weights bearing an image of the emperor, there are one or more halos accompanied by an inscription or monograms.

The emperor was seldom shown wearing a headband called diadem, or a crown. The use of the emperor's bust proved that the accuracy of the weight has been confirmed by the government.

Unlike lead and bronze, glass has non-corrosive properties, and if the weights were switched, it was easier to detect than metals, features that made glass weights preferred in the Byzantine Empire.

Studies have shown that there are more than twenty types of glass weights with iconographic characters stamped on them. These weights show the dates of an emperor's reign or a governor's service and make it easy to make historical comparisons.

Even though semi translucent colors are often found, most glass weights were in the hues of blue and green, which was made possible by using iron and cobalt oxide.

Dirhems of Different Sizes,

Dirhems: The word *dirhem* is derived from the Greek *drachma*, which was borrowed first by Persians and later by Arabs as a result of trade relations. The *dirhem* served both as a unit of weight and as currency, which points to a time when coins were valued according to their weight. The Seljuks adopted the *dirhem* system as used by the Umayyads, Abbasids and Iranians, but the unit's value varied from region to region. The weight of the *dirhem* and *mislaks* also change by region and by period, as we learned through local sources.

The *dirhem* weights with Anatolian motifs were produced by casting. Although this technique may have been borrowed from the Seljuk's, there are no stamps or inscriptions allowing us to identify the period.

However, the Ottomans continued to stamp *dirhem* weights that had been used in earlier periods. The *dirhem* weights of the Ottoman Period continued to have similar motifs as well.

As Islam spread in Anatolia, Islamic weights also began to appear alongside Byzantine ones. *Dirhems* with Anatolian motifs were used during the Beylik era, after the collapse of the Seljuks. The Ottomans also adopted these *dirhem*s and casted the same ones. As we can see from the *dirhems* that survived to our present day and appear in this collection, most Ottoman sultans stamped their signature on the back of the *dirhem* to prove the measurement system had been strictly inspected by the state.

Did you know?

The story of the Turkish idiom, "Chic as two dirhems and a seed"
It is always nice to have your look match your fresh outlook on life. Elegant clothes serve as a reference to your character, and your appearance reflects your personality. Dressing up for work, for meetings or any social occasion is an important aspect of life.

The carob seed is one of those seeds in nature that does not lose its integrity or weight. In the Ottoman and Arabic world, carob seeds were used as measuring units. And the carat, which is used for measuring diamonds, equals one apricot seed. The seeds mentioned in the idiom "Chic as two dirhems and a seed" refers to carob seeds. Sixteen carob seeds equaled one *dirhem*.

Dirhem is a quarter of an *okka,* an ancient unit of weight. An *okka* weighed 1283 grams, and a seed weighed 5 centigrams.

The old Ottoman gold coin equaled the weight of two *dirhems* and a seed, which is approximately 6.43 grams. So, to tell someone their outfit is "as fancy as gold", people would say "chic as two dirhems and a seed". In effect, this meant the chic person looked like gold.

Iron-brass *Arşın* of the Marketplace, 19th century, 68.2 cm

Marketplace Arşın and Endaze: *Arşın* is derived from the Persian Word "ers" and corresponds to the length from the elbow to the end of the middle finger. The Ottomans used three different types of *arşın*: the architect's *arşın* (75.8 cm), marketplace *arşın* (68 cm) and endaze (65 cm). The architect's *arşı*n was used for measuring land and buildings whereas the marketplace *arşın* and endaze were used for measuring fabrics, carpets, and other similar products in markets and bazaars.

Brass *Qibla-numa*, 19-20th century, 230 x 230 mm

Qibla-numa: *Qibla-numa* was used to determine the location of the Kaaba before devices showing the time and location were common. Featuring a simple compass, a pointer and city names on top, the *qibla-numa* looks like a pocket watch.

Plummet, Ottoman Period

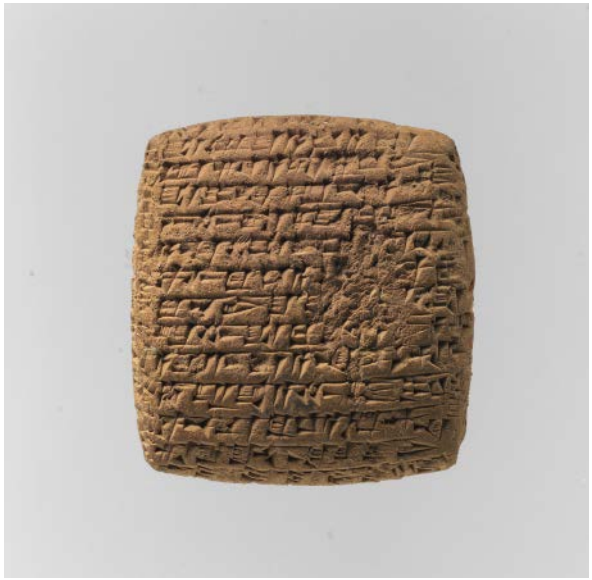
Plummet: Known as the plumb bob or a plummet, this device uses gravity to establish a vertical datum. Used in Egypt for the first time in 3000 B.C., it consists of a weight that is attached to a plumb line. To eliminate the effects of the wind, plummets have special weight points and are typically used in mining, architecture and construction.

Brass Set Square, 16th-20th century

Set Square: This device that has a right triangle shape is used in engineering, mathematics and technical drawings. The Turkish word for set square, "gönye", comes from the Greek, "gonia".

Compass and Ruler set, Ottoman, July 22, 1903

Pair of Compasses: Featuring two connected legs, the compass is used for drawing circles or arcs. One of the legs is stabilized on paper or the material where a circle is wished to be drawn on, while the other leg holds a pencil or another drawing tool. Depending on its use, compasses can be designed in different sizes or shapes.



Replica of a Clay Tablet. Kültepe,
20th -19th century B.C.
© The Metropolitan Museum of Art, New York

Clay Tablet: In the Ancient Near East, clay tablets were used for writing in cuneiform during the Bronze and Iron Ages.

In this replica of a clay tablet, Ilabrat-bani writes to Amur-ili, who comes from a well-known merchant family, and tells him about the textiles that were delivered to the trade region, talks about his need for more clothing items, and tells him that he would be happy to give him some advice about the trip.

The use of weights and measures by perio

A scene from the Book of Dead of the scribe Hunefer, Egypt, 2nd century B.C.
© The Trustees of the British Museum

Early Period: Although it was easy to weigh things in the Ancient Near East, creating units for these measurements was a complex conceptual step. The Mesopotamian civilizations had set the ground for creating a weight unit using barley pieces, based on their daily practices. Egyptians went beyond this life and used the metaphor of weighing the soul of their dead, trying to give meaning to the afterlife. However, accepting our inability to measure the soul was as equally difficult thousands of years ago as it is now.

In the beginning of the 2nd century B.C., more than a dozen city-states were established in Central Anatolia. Kültepe, situated on the hills of Mount Erciyes, acted as a bridge that connected Assyria and the rest of Anatolia. Over 20 thousand clay tablets found in the excavations in Kültepe, dating from 1920 to 1740 B.C., mention *karums* (large markets) and *wabartums* (small markets) that were established on the trade route between Anatolia and Assyria. The Assyrian merchants who had come to the area for trading textiles and metals had made inscriptions on these tablets using the old Assyrian language called Akkadian. They consisted of notes on how to follow up on their communication, transportation, and travels, and these tablets introduced writing to Anatolia.

© The Trustees of the British Museum

Merchants carried their goods in caravans and travelled for weeks. The goods, typically carried by donkeys, were scaled, and would be no more than 130 minas per donkey (approximately 65 kg). They were weighed and divided into portions, half bags on each side of the donkey and a whole bag on top. Once they arrived at Anatolia, the merchants sold everything, including the donkeys.

The heaviest unit of weight used by the Near Eastern civilizations, including the Hittites, Babylonians and Assyrians, was the talent, which equaled 60 minas. In Mesopotamia, animal-shaped weights made of rock or metal, and cylindrical weights made of hematite were very common. In Ancient Syria, most weights were made of hematite, and in Babylon they typically consisted of agates and hematite.

Ancient Greek Period: 1200 B.C., the Late Bronze Age witnessed the collapse of many civilizations. The Hittites of Anatolia, the Assyrian Empire in Syria and North Mesopotamia, and Mycenae in mainland Greece disappeared. The ancient cities were deserted, and the trade routes disappeared.

During this period marked by the absence of a centralized state, the Ancient Greeks, who had expanded their presence in Asia Minor between the 9th and 6th century B.C., established city-states, called the polis.

The city-states began to identify themselves with their unique symbols. These symbols (*parasemon*) we commonly come across on coins and scale weights and the myths around them carry the marks of a cultural life that revolved around economic activity.

> ***A trade center: Agora***
> If you ask, "How much is the sea bass?", the fisherman replies "Ten obols," but doesn't tell you what type of obol. Then you take out your silver to pay, but he asks you to pay in the Aegina standard. If he needs to return some change, he pays you back with the Attica standard, and each time, he charges you an exchange fee.
>
> Diphilus, *Polypragmon*

The *Agora*, an open space surrounded by four walls, was used for trade and socializing.

In Antiquity, only men, slaves or older women shopped at the agora, as it was considered inappropriate for rich people or young women to be there. Each city had at least one agora, and large cities or port cities had more than one. The rules regulating commerce were inscribed on a rock and placed in a suitable space in the agora.

The exported and imported goods in the bigger city markets were brought by land through the two Silk Roads below the Black Sea, and also by water, through the Red Sea, Persian Gulf and Indian Ocean. The Royal Road was one of the main arteries of the Silk Road. Commodities such as olive oil, wine, pottery, furniture, weapons, personal accessories and jewelry were exported, and certain raw materials, such as metal and rocks, were imported.

In the ancient Greek system of weights, the talent was the largest unit, and 1 *talent* = 60 *mina*= 100 *drahmi*.

> ***Justice at the Marketplace***
>
> Like the Egyptians who used the scale to weigh people's sins, in addition to commodities, the Ancient Greeks also used the scale as a symbol of justice.

Terracotta amphora depicting weighing of merchandise.
Taleides the Painter, ca. 540-530 B.C.
© The Metropolitan Museum of Art, New York

Stele depicting a banker,
Viminacium, 3rd century A.D.
© Narodni Muzej u Beogradu

A fair banker
Pasion was a successful and rich banker from Athena. Originally a slave to two bankers, Antisthenes and Arkhestratos, Pasion established his own bank after his owners set him free due to his loyalty. He became very successful and set up branches in the Aegean and the Black Sea. When he died in 370 B.C., his fortune was worth 40 *talents*.

Demosthenes,*Speeches*

Roman Period: In 129 B.C., the Roman Republic announced its sovereignty over Anatolia and established the Asia State, with Pergamon as its capital. With its rich cities and large trade network, the Roman government brought prosperity to Anatolia. During this period, which lasted about 400 years, the west of the Roman Empire was under the influence of the Latin culture, and the east, under the influence of ancient Greek culture and language.

In Ancient Rome, the *forum* (marketplace) was found in the center of town, and it was surrounded by temples, basilicas and shops. Villagers, farmers or small craftsmen set up tables in the streets around the forum to sell their products. Most people did their own shopping, whereas rich people sent their slaves to the market.

A Roman Invention: Statera
The steelyard hand balance (*statera*) invented by the Romans in the 1st century B.C. was a single-arm balance used for weighing heavier commodities.

Even though it varies by period, the Roman *libra* was considered 327.45 grams.
In Late Antiquity, the *libra* was 324 gr, the *uncia*, 27 gr, and the *solidus*, 4.50 gr.

Byzantine: During the Byzantian times, Constantinople was the center of economy and trade, in addition to being an administrative, military and religious center. Accurate weights and measures were essential for smooth commerce. Steelyard weights in the forms of the empress' bust became symbols of wisdom, legality, prosperity, and good luck. To increase the legality of the trade at the markets, steelyard weights in the form of Athena's bust were used. A "fair" or accurate weighing also showed good morals, reminding people of weighing their souls.

Detail from the Sacra Parallela manuscript, 9th century A.D.
© National Library of France

Interior of an inn's courtyard in Bergamon, 19th century.
© Deutsches Archaologisches Institut Istanbul

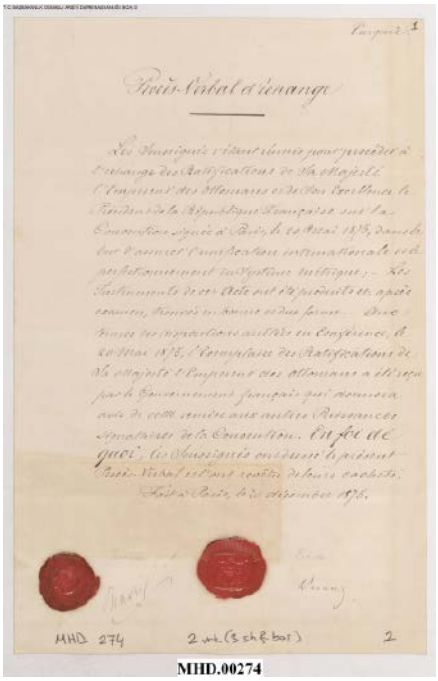
Ottoman Period: In Late Antiquity, Constantinople was the center of politics and trade and had a population of half a million people. In the 15th century, with the Ottoman conquest of the city, the trade centers of this capital continued to display its Byzantine heritage with a new identity.

The Seljukian trade routes and caravanserais, a prominent feature of Anatolian history in the Middle Ages, set an example in terms of economic policy for the Ottoman state, which was expanding its borders.

The shopkeepers, who were the most important commercial figures of the city, were predominantly found in the Eminönü, Beyazıt, Süleymaniye, Mahmutpaşa, and Tahtakale districts, and the commercial center was the Grand Bazaar.

The commercial activities in the Ottoman Period revolved around closed bazaars called *han, bedesten* and *arasta*, and as well as the open-air markets and fairs that were set up near these. The *muhtesib,* authorized by the judge, *kadı*, were responsible for the orderliness of the markets and bazaars. The weights that were inspected would bear the stamps, "ayar tam" (accurate), "ayar şod" (accuracy fixed), and "imtihan" (needs testing), and fraudulent weights would be collected and taken out of circulation.

Miniature of a punished merchant, from the Ralamb Album of Turkish Costumes, 17th century. © National Library of Sweden



Contract on the use of the meter and the kilogram, signed with France December 20,1875. BOA, MHD.00274

Bakeries and moneychangers were often inspected. Bakers who sold underweight bread were punished in various ways, including the nailing of their ear to the shop door, foot whipping, penalty fines, and confiscation of property or being banned from the trade. Punishment for forgers included rowing in the galley ships, imprisonment and even execution.

It was a common practice to solder an additional circular weight to increase heaviness. Weight adjustment was made also by reducing the small circular motifs on the weights.

The Ottoman State officially passed the "Metric System" law in 1869, to standardize weight and measurement units across all territories, and to increase its trading volume with Europe. With this law, *zira-i aşari* (meter), *dirhem-i aşarî* (gram) and *ölçek* (litre) were recognized as the official length, weight and volume units, respectively, of the state.

The first weight and measurement units in the metric system were brought from France. In the 60 years following the law of 1869, traditional Ottoman and the metric units co-existed in the Empire's lands. With the "Law on Measures and Weights" issued by the government of the Turkish Republic in 1931, the metric system became completely mandatory.

Navigating Ottomans: Engineer Feyzi Efendi
Feyzi Efendi was an Ottoman engineer, raised in the Palace School in Istanbul. He was fascinated by "this observational tool found in a box, called a sextant", and wrote a book in 1805, titled *Muhâdarât-ı Feyzi,* on how to use the sextant to measure heights by calculating logarithms.

Measuring the Unmeasurable
In the history of measuring, time is the ultimate example of how civilizations attempted to measure the unmeasurable. Today, we still use the same system developed by the Ancient Greeks, who were inspired by the Babylonians, and divide an hour into 60 minutes, and each minute into 60 seconds.

Feyzi Efendi holding a sextant. Muhâdarât-ı Feyzi, 1805. © İstanbul University Library of Rare Works

Before mechanical clocks were common, the quadrant and astrolabe used in astronomy, as well as a device called *qibla-numa*, were commonly used in the Islamic states to determine prayer times and the direction of Mecca.

Although mechanical clocks were invented in the 13th century, they did not appear in the Ottoman State until the end of the 15th century. The chief court astrologer of Sultan Selim II, Takiyüddin, talks about these clocks as "devices that are hard to construct and require many modest workers.". These clocks, which acquired their power from their weight, were unique in terms of shape, dial and gears, qualities that distinguished each clock maker.

Did you know?

What did pharmacists use in the past? How were medicinal drugs made?
Pharmacists were extremely careful about weighing the ingredients used in the drugs and employed personalized balance sets to this end. It was common to inscribe the name of the pharmacist either in Latin or in French on the visible side of the balance set. In Ottoman pharmaceutical tradition, the main units of weight were the *dirhem* and the *miskal*. During both the Seljuk and Ottoman periods, the formulas in the pharmaceutical guidelines were based on the *dirhem*. As medicine progressed and the ingredients in drug making became more varied, there was a need for a more accurate measuring of medicine doses and consequently, the hand balances were replaced first with the brass balance and then, eventually, with the precision scales used by the modern pharmacies to prepare medical prescriptions, in the 20th century.

How did sailors navigate?
Before the invention of the compass, sailors found their direction by observing the position of the stars. The invention of the compass made it safer for sailors to leave land, increased maritime trade and facilitated the geographical discoveries. It is known that the compass was first invented in China in the 1st century A.D. Later, the Arab merchants introduced the Chinese invention to Europe, and it was commonly used in the 1200s during the Crusades, encouraging more sailors to test the open waters.

How did mail workers weigh letters?
Mail workers used a pocket scale shaped like an envelope to weigh the letters and calculate the fee required.

How did architects design buildings without modern tools?
By drawing, working on drafts and conducting measurements on the actual area.

How did moneychangers measure gold?
Moneychangers knew the purity level of gold and silver well, weighed them on precision scales and charged money for these services. These scales used for measuring coins were small enough to be carried in a pocket and were hence called "pocket scales". On one side of the scale there were notches indicating the weight of coins. When the coins were placed in these notches, if the coin fell, it meant that it was at the correct weight. If it stayed above the notch, it was counterfeit or underweight.

What were some of the major trade routes in Anatolia throughout history?
Due to its geographical location, Anatolia has hosted many civilizations since ancient times and always acted as a crossroad and a bridge between the East and the West. Consequently, there were many routes that crossed through Anatolia, each featuring different directions and characteristics in different periods.

Royal Road
It is estimated that the construction for the Royal Road began during the reign of Kyros, the Persian King, and was completed during Dareios I's reign (5th century B.C.). Spanning 2500 kilometers, the Royal Road started at the capital city of Susa, near the Persian Gulf, and passed through Melitene (Malatya), Mazaka (Kayseri), Ankyra (Ankara), and Gordion (Yassıhöyük), ending at the Lydian capital of Sardeis.

Silk Road
The transport of silk, spices and other products from the East by caravans to the West, all the way from China to Europe, created the trade routes known as the "Silk Road". These routes did not only involve commercial but also cultural exchanges between the East and the West. Anatolia was one of the most important junctions of the Silk Road. During the Middle Ages, the Silk Road started from China, followed a few different routes in Central Asia, connected in Anatolia, which acted as a bridge, and continued to Europe through Thrace. The road also used maritime routes from the Aegean ports of Ephesos (Efes) and Miletos (Milet), the Black Sea ports of Trapezous (Trabzon) and Sinope (Sinop), and the Mediterranean ports of Alaiye (Alanya) and Adalya (Antalya) to connect to Europe.

Why did people have to trade?
When agriculture was discovered, major changes took place in human activities. Before, people had to be both physically fit and mentally astute to find food and survive. After the invention of agriculture, people began to depend on others to survive. This allowed them to develop their talents in other areas. For example, while one person created tools, another learned to grow wheat and another harvested fruits and vegetables. As agriculture developed, people began to form groups, which formed communities, and which in turn formed small cities. With cities came defensive structures, armies, and trade. Exchanging a commodity that is not needed by a community, in other words, bartering without any economic sacrifice lies at the heart of the economic relations that took place before commercial trade.

How did bartering start?
During the Stone Age, people traded through bartering. This was a useful activity at that period, as it promoted development through acquiring new goods.

The expansive use of metals as commodities in the Early Bronze Age (3000-2000 B.C.) proves that exchanging and bartering were common activities in the market. By studying the different types and sources of metals, we can understand the dynamics and the extent of the trade between metal producing and metal consuming communities. In addition to practicality and the prestige they brought to daily life, metals have also been used as a monetary unit, which gave them a central role in economic development. The use of metals as a monetary unit proves a basic economic understanding in this period. The mining and processing of metals, particularly metal tinning, shows the changing approach towards metal, and a new appreciation for its value and the areas that it could be used in.

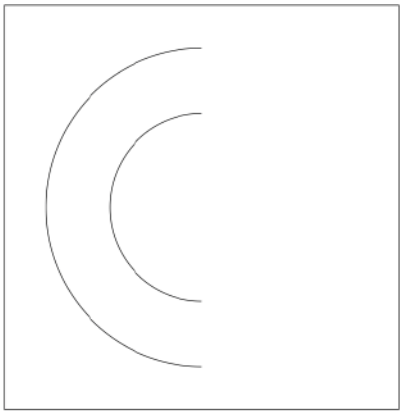
(Source: *The Role of Metals in the Early Bronze Age Economies of North Syria and Anatolia*, Heather Elizabeth Snow, University of Toronto, 2005.)

Activity Suggestions
Venue: Pera Museum, 1st Floor
Exhibition: Art of Weights and Measures
Methods and Techniques: Geometric Shapes and Role-playing
Age Group: 4-6

Materials: Dirhem template and colored pencils

Learning Outcome: Geometric shapes and colors

Method:
Complete the Artifact and Act it Out: During the exhibition tour, the teacher asks students to pay attention to artifacts with geometric shapes. At the end of the tour, the teacher gives out the templates and students complete the rest of the shape and color it. At the end of the activity, the students act out the colored template.



You can find the related template on the last page of the booklet.

Venue: Pera Museum, 1st Floor
Exhibition: Art of Weights and Measures
Methods and Techniques: Frozen Image
Age Group: 7-8

Materials: The teacher selects a few of the artifacts before visiting the museum and studies them with the students at the museum (Images of the artifacts are available on the Pera Museum website).

Learning Outcomes: Observing the historical development of the artifacts found at the Art of Weights and Measures. .

Method:
1) Find the match: First, the students are asked to do a self-guided tour of the exhibition. Then, they meet back and are formed into groups. After talking about the time periods reflected in the exhibition, each group is given a few images of the artifacts and they are asked to find the actual artifacts.
2) Role-Playing: The frozen image method is an easy to use and practical technique that involves participants using their own body to form an image without using any words or sounds. After the groups match the images they were given with the artifacts, they are asked to role play the occupation (pharmacist, scientists, astronaut, engineer, architect, etc.) They stand in front of the artifacts and perform a frozen image of that occupation. After all groups have completed this task, the group discusses the frozen images.

Venue: Pera Museum, 1st Floor
Exhibition: Art of Weights and Measures
Methods and Techniques: Game and Role Playing
Age Group: 9-10

Learning Outcomes: Observing the historical development of the artifacts found at the Art of Weights and Measures.

Method:
1) What does it have?: Students are asked to study the artifacts in the exhibition and pick one. They are given additional time to observe their artifact. They then meet around a circle, and one of the students is selected to go in the middle. All other students ask the student in the middle for clues to find the artifact that the student had selected, saying "What does it have? With each question, the selected student needs to talk about the features of the artifact, such as its color, shape, or how it is used. The student that guesses the right answer will become the next one to go in the middle. The game is repeated a few times with different students in the middle.
2) Role Playing: The teacher forms student groups, and each group picks an artifact. Next, they describe using their bodies the way that artifact is used.

Venue: Pera Museum, 1st Floor
Exhibition: Art of Weights and Measures
Methods and Techniques: Story Telling
Age Group: 11-12

Suna and İnan Kıraç Foundation Anatolian Weights and Measures Collection

Learning Outcome: Identification of the weights from the Islamic Period, which influenced Viking weights, in the Anatolian Weights and Measures Collection.

Materials: The teacher shares the story of the Vikings with the students at the museum.

The Vikings were dominant in the period between 800 and 1100. The group we know today as the Vikings were a group mostly from Scandinavia, and they did not call themselves Vikings. A rare British source from the 11th century mentions a group called "Wicingas". The Vikings had a very active trade life and traveled from region to region. This cultural interaction inevitably had effects on the economic system.

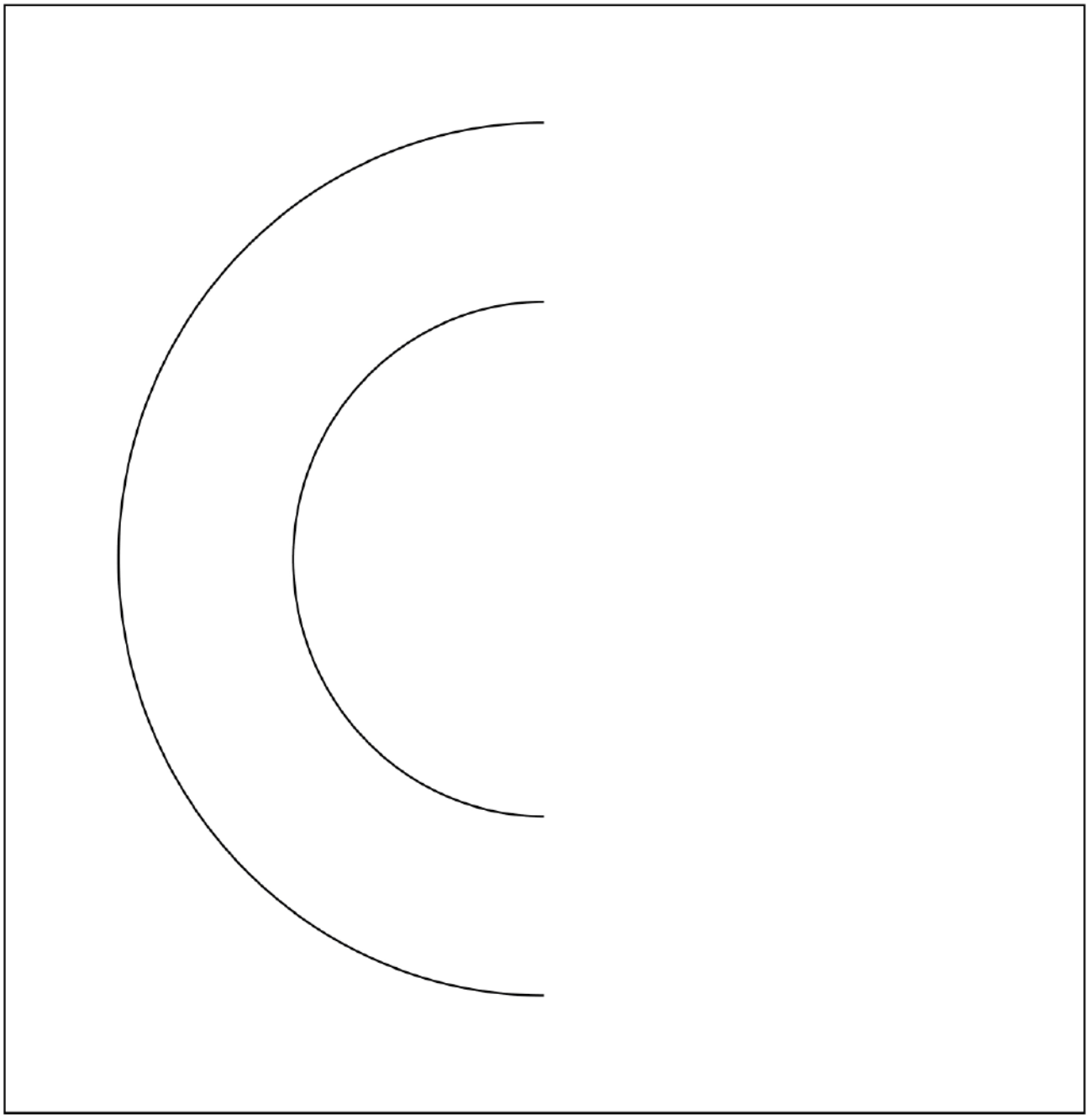
Having a reliable weights and measurement system is essential for trade. In the 9th century, the Vikings circulated commodities and used them for payment. With their long-distance trade with the Carolingian Empire the Vikings adopted the units of weight used by this empire. In the second half of the 9th century, Vikings developed trade relations with the Baltic regions and the Islamic world and used silver for weight. One of their main sources of silver were the silver Islamic coins, and it is believed that this interaction played a major role in standardizing the weight system in Scandinavia.

Method:

Story Telling: Storytelling is a method that brings a depth to cultural heritage. In this activity, the teacher shares the story above with the students and asks them to finish it. The teacher can crop the story wherever they see fit. This way, the students can recreate the emotions and stories that form the backdrop of cultural heritage items.

Complete the Artifact and Act it Out

Template



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