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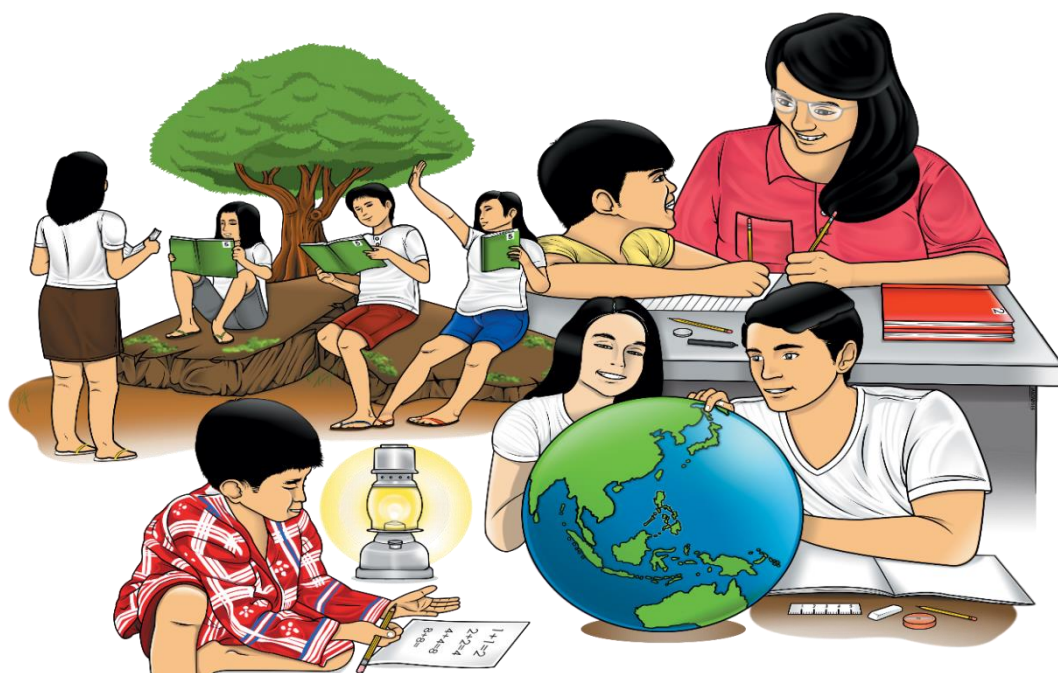
**Senior High School**

# **Physical Science**

## **Quarter 2 – Module 1:**

### **Models of the Universe**

#### **(Greek Astronomy to Kepler)**



**Physical Science – Grade 12**  
**Alternative Delivery Mode**  
**Quarter 2 – Module 1: Models of the Universe (Greek Astronomy to Kepler)**  
**First Edition, 2020**

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**Development Team of the Module**

**Authors:** Erickson F. Del Mundo

**Editors:** Joey H. Villanueva, Arlene C. Malaybalay

**Reviewers:** Tommy R. Rico, Emitterio D. Macarubbo, Maricris N. Surigao

**Illustrator:** Erickson F. Del Mundo

**Layout Artist:** Justine C. Montoya

**Management Team:** Wilfredo E. Cabral, Director IV

Jennifer F. Vivas, CLMD Chief

Dennis M. Mendoza, Regional EPS in-charge of LRMS

Micah S. Pacheco, Regional ADM Coordinator

Jocelyn M. Aliñab, CID Chief

Tommy R. Rico, Division in-charge of LRMS

and Division ADM Coordinator

**Department of Education – National Capital Region**

Office Address: Misamis St., Bago Bantay, Quezon City

Telefax: 02-929-0153

E-mail Address: depedncr@deped.gov.ph

# **Physical Science**

## **Quarter 2 – Module 1: Models of the Universe (Greek Astronomy to Kepler)**

This instructional material was collaboratively developed and reviewed by educators from public and private schools, colleges, and or/universities. We encourage teachers and other education stakeholders to email their feedback, comments, and recommendations to the Department of Education at [action@deped.gov.ph](mailto:action@deped.gov.ph).

**We value your feedback and recommendations.**

# Introductory Message

For the facilitator:

Welcome to Physical Science Grade 11/12 Alternative Delivery Mode (ADM) Module on the topic Models of the Universe (Greek Astronomy to Kepler)!

This module was collaboratively designed, developed, and reviewed to assist the teachers/facilitators in helping the learners meet the standards set by the K to 12 Curriculum while overcoming their personal, social, and economic constraints in schooling.

This learning resource hopes to engage the learners in guided and independent learning activities at their own pace and time. Furthermore, this also aims to help learners acquire the needed 21st - century skills while taking into consideration their needs.

In addition to the material in the main text, you will also see this box in the body of the module:



## ***Notes to the Teacher***

This contains helpful tips or strategies that will help you in guiding the learners.

As a facilitator, you are expected to orient the learners on how to use this module. You also need to keep track of the learners' progress while allowing them to manage their learning. Furthermore, you are expected to encourage and assist the learners as they do the tasks included in the module.

For the learner:

Welcome to Physical Science Grade 11/12 Alternative Delivery Mode (ADM) Module on the topic Models of the Universe (Greek Astronomy to Kepler)!

Our hands are the most represented parts of the human body. It is often used to depict skill, action, and purpose. With our hands, we create, accomplish and learn. Hence, you are capable and empowered to successfully achieve the relevant competencies and skills at your own pace and time. Your academic success lies in your own hands!

This module was designed to provide you with fun and meaningful opportunities for guided and independent learning at your own pace and time. You will be able to process the contents of the learning resource while being an active learner.

This module has the following parts:



***What I Need to Know***

This will give you an idea of the skills or competencies you are expected to learn in the module.



***What I Know***

This part includes activity that will check what you already know about the lesson. If you get all the correct answer (100%), you may decide to skip this module.



***What's In***

This is a brief drill or review to help you link the current lesson with the previous one.



***What's New***

In this portion, the new lesson will be introduced to you in various ways such as a story, a song, a poem, a problem opener, an activity, or a situation.



***What is It***

This section provides a brief discussion of the lesson. This aims to help you discover and understand new concepts and skills.



***What's More***

This comprises activities for independent practice to solidify your understanding and skills of the topic. You may check the answers to the exercises using the Answer Key at the end of the module.



***What I Have Learned***

This includes questions or blank sentences/paragraphs to be filled in to process what you learned from the lesson.



***What I Can Do***

This section provides an activity that will help you transfer your new knowledge or skills into real-life situations.

**Assessment**

This is a task which aims to evaluate your level of mastery in achieving the learning competency.

**Additional Activities**

In this portion, another activity will be given to you to enrich your knowledge or skill of the lesson learned.

**Answer Key**

This contains answers to all activities in the module.

At the end of this module you will also find:

**References**

This is a list of all sources used in developing this module.

The following are some reminders in using this module:

1. Use the module with care. Do not put unnecessary mark/s on any part of the module. Use a separate sheet of paper in answering the exercises.
2. Don't forget to answer *What I Know* before moving on to the other activities in the module.
3. Read the instruction carefully before doing each task.
4. Observe honesty and integrity in doing the tasks and in checking your answers.
5. Finish the task at hand before proceeding to the next activity.
6. Return this module to your teacher/facilitator once done.

If you encounter any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator. Always bear in mind that you are not alone.

We hope that through this material, you will experience meaningful learning and gain a deep understanding of the relevant competencies. You can do it!



## ***What I Need to Know***

This module was created to give you an overview of the development of the models of the universe from ancient Greeks to the laws formulated by Johannes Kepler.

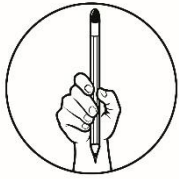
The module will focus on the concepts of astronomy known to the Greeks and the laws of planetary motion.

The learners are expected to:

- (a) explain how the Greeks know that the Earth is spherical S11/12PS-IVa-38;
- (b) cite examples of astronomical phenomena known to astronomers before the advent of telescopes S11/12PS-IVa-4;
- (c) explain how Brahe's innovations and an extensive collection of data in observational astronomy paved the way for Kepler's discovery of his laws of planetary motion S11/12PS-IVb-44.

After going through this module, you are expected to:

- 1. discuss how Greeks knew that the Earth is round;
- 2. describe how Eratosthenes came up with the measurement of Earth's circumference;
- 3. cite examples of known astronomical phenomena before the advent of telescopes;
- 4. distinguish between the Ptolemaic, Copernican, Tycho's, and Keplerian models of the Solar system;
- 5. discuss how Brahe's works became instrumental in the formulation of Kepler's discovery laws of planetary motion.



## ***What I Know***

DIRECTIONS: Read each question carefully. Choose the letter of the best answer. Write your answer on a separate sheet of paper.

1. Which BEST explains why the Earth is not disk-shaped?
  - A. Stars are viewed differently when traveling north and south.
  - B. The shadow cast by Earth during a lunar eclipse is circular.
  - C. The shadow cast in two different cities during a solstice differed in length.
  - D. The only shape that cast a circular shadow in whatever direction is a sphere.
2. Which of the following is an annual motion?
  - A. Moonrise
  - B. Eastward rise of stars
  - C. Sunset
  - D. Vernal equinox
3. What astronomical event was NOT known to men before the advent of telescopes?
  - A. Solar eclipse
  - B. Summer solstice
  - C. Retrograde of Mars
  - D. Rotation of the Sun
4. Which aided Eratosthenes in measuring the Earth's circumference?
  - A. The appearance of stars differs when travelling from north to south.
  - B. The shadow cast within the Syene and Alexandria during the solstice.
  - C. A sphere is the only shape that cast a circular shadow in whatever direction.
  - D. The shadow cast by the Earth during a lunar eclipse is circular.

For nos. 5-6, choices are

- A. Autumnal equinox
  - B. Eastward rise of stars
  - C. Summer solstice
  - D. Zodiac cycle
5. What is a diurnal motion?
  6. Which does NOT involve the Sun's ecliptic path?

For nos. 7-10, choices are:

- A. All planets revolve around the sun in an elliptical orbit.
  - B. Any point in the closed curved is equidistant to the two foci.
  - C. Planets move fastest in the elliptical orbit when nearest to the sun.
  - D. The length of a planet's revolution in the Sun is proportional to its orbit's size.
7. Which describes the law of ellipse?
  8. Which describes the law of harmony?
  9. Which describes the law of equal areas?
  10. Which explains the difference in the orbital period of Earth and Saturn?



For nos. 11-15, choices are:

- A. Copernican
- B. Keplerian

- C. Ptolemaic
- D. Tychonic

11. Which presents a system with elliptical orbit?
12. Which presents a heliocentric model of the universe?
13. Which presents a geo-heliocentric model of the solar system?
14. Which attributes retrograde motion of the planets to epicycles?
15. Which states that a planet moves fastest when it is nearest to the sun?

## Lesson

# 1

## MODELS OF THE UNIVERSE

The model of the solar system today traces its history back to the ancient Greek astronomy.



### What's In

You have studied the sun, moon, stars, and other celestial bodies in your Elementary Science. As you move to Junior High School, you came to understand the occurrence of eclipses, solar system, and constellations. Likewise, in the previous quarter, you have learned how the elements in the universe originated from the Big Bang. In this module, we will look at the views of the ancient Greeks about the universe and understand how the model of the Solar System originated.



### What's New

#### Activity 1

The objective of this activity is to familiarize the coordinate system of the celestial sphere. Identify what is asked on each item using Figure 1 your reference.

1. equivalent to the Earth's north pole
2. equivalent to the Earth's south pole
3. equivalent to the Earth's latitude (north-south location)
4. equivalent to the Earth's longitude (east-west location)
5. path which the sun appears to take in the celestial sphere
6. point in which the ecliptic intersects with the celestial equator

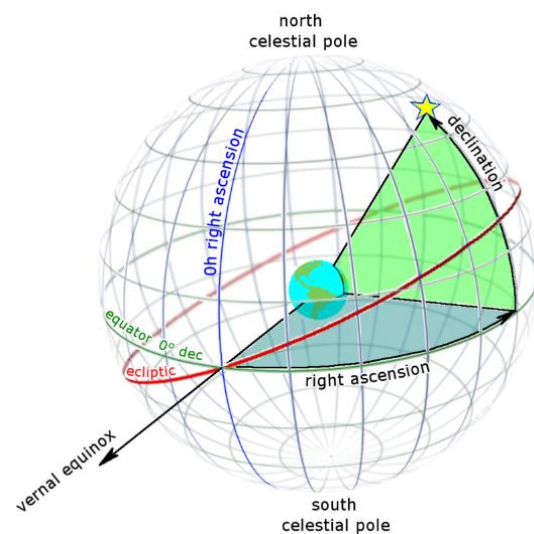


Figure 1 The celestial sphere

By Tfr000 (talk) 15:34, 15 June 2012 (UTC) - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=19907447>



## What is It

### HOW GREEKS KNOW THAT THE EARTH IS ROUND

Even before Plato, the Greeks have deduced that the Earth is spherical based on the observation that the shadow cast by the Earth during a lunar eclipse is circular and that the only shape that can cast a circular shadow at whatever direction it is pointed is a sphere. The Greeks were also able to measure the diameter of the Earth. The Greeks also noted that the stars are viewed differently as they travel north and south.

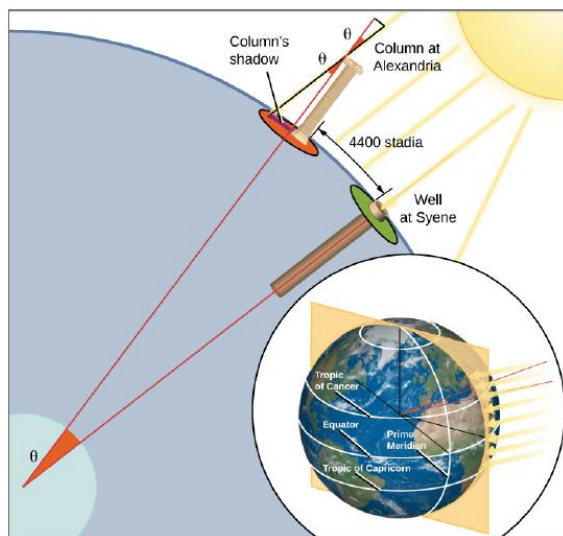


Figure 2 Eratosthenes' measurement of the Earth's circumference

From Ch. 2 Observing the Sky: The Birth of Astronomy—Astronomy p. 44 | OpenStax. (2016).  
Download for free at  
<https://openstax.org/details/books/astronomy>.

Eratosthenes, a Greek Mathematician, told that no vertical shadow was cast as the sun rays fall vertically in the city of Syene in Egypt during summer solstice. Eratosthenes noted that at the same time a shadow was cast as the sun rays fell at an angle of  $7.2^\circ$  [one fiftieth ( $1/50$ ) of a circle in ancient Greek writings] in the city of Alexandria. He assumed that the sun was so distant that the rays fall parallel to each other on the Earth's surface and that the difference in the shadows cast in the two cities was due to the curvature of Earth's round surface. The distance between Syene and Alexandria was found to be 5000 stadia (approx. 800 km). Thus, Eratosthenes thought the Earth's circumference must be  $50 \times 5000$  stadia or 250,000 stadia (40,000 kilometers). Now, what is the significance of the spherical shape of Earth? The sense of symmetry by Greeks demands a spherical Earth located at the center of the sphere of heavens.

### ASTRONOMICAL EVENTS KNOWN TO MEN BEFORE THE ADVENT OF TELESCOPES

Before the advent of telescopes, humans depended on their senses to grasp the universe. Ancient Babylonian, Assyrian, and Egyptian knew the length of the year and Egyptians, adopted a calendar based on 365 days a year. The Egyptians also kept track of the yearly cycle of the star Sirius which corresponds to the flooding of Nile. Early Chinese civilizations kept track of the comets, meteors, and dark spots of the Sun. Mayan civilization also developed a calendar based on the movements of Venus. Meanwhile, the Polynesians utilized the stars for navigation.

Below are astronomical events before telescope was invented.

## Diurnal Motion

In modern astronomy, diurnal motion is defined as the apparent daily motion of stars and other celestial bodies across the sky due to Earth's rotation. Man has observed the sun rising from the east and set in the west. The Greek astronomers have described 'fixed stars' moving in the sky at the same arrangement and speed as most of the stars are. Stars whose movements deviate from what seems to be fixed stars were called '*planetes*' which means 'wandering stars' in Greek. The seven wandering stars are the Sun, moon, Mercury, Venus, Mars, Jupiter, and Saturn.

## Annual Motion

Annual motion is the apparent yearly motion of stars and other celestial bodies across the sky due to Earth's revolution. Below are events under annual motion.

### Zodiac and the Ecliptic

If we trace the path the sun takes in the celestial sphere as we see on Earth, we would have traced the ecliptic. A band of thirteen constellations collectively called zodiac can be seen in the ecliptic. Ancient civilizations have observed that these constellations changes through months as constellations are visible at different times in a year. These constellations served to mark the time for planting and used by astronomers to develop a chart called horoscope.

### Equinoxes and Solstices

Equinoxes are the two days in a year in which the sun crosses the celestial equator occurring near March 20 (vernal equinox) and near September 22 (autumnal equinox). Midway between these two equinoxes is the solstices. Solstices are the two days in a year in which the Sun is at the farthest declination (north or south) from the celestial equator. Ancient Greeks and Early Chinese civilizations have recorded solstices by observing the declination of the sun for several days before and after the solstice. The calculated half-way between the days with the equal declination of the sun at noon would be the solstice. This method also applies for equinoxes.

## Precession

Hipparchus in 150 BCE has discovered based on his observation that the north celestial pole has changed during the period of a half - century. He noticed that the slow and continuous change in the direction in which the sky is moving. We understand at present that precession is the slow 'wobbling' of Earth's axis of rotation due to the gravitational pull of the Moon and Sun. Figure 3 illustrates the 26,000-year cycle of precession. About 5,000 years ago the north celestial pole is located at the star Thuban. At present, the

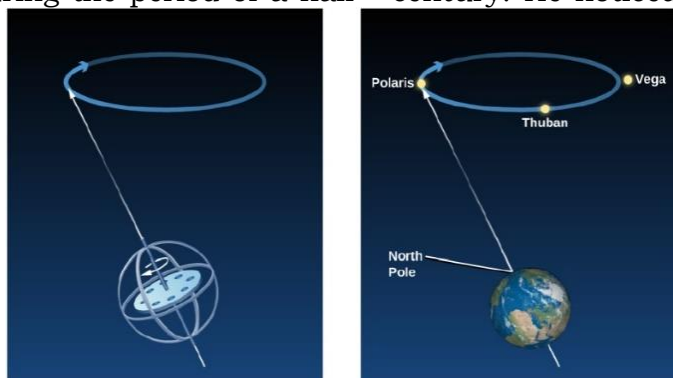


Figure 3 Precession of the Earth

From Ch. 2 Observing the Sky: The Birth of Astronomy—Astronomy  
p. 47 | OpenStax. (2016). Download for free at  
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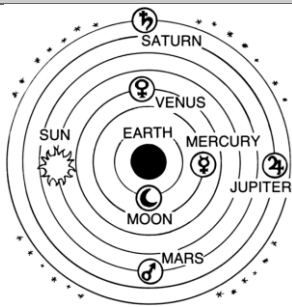
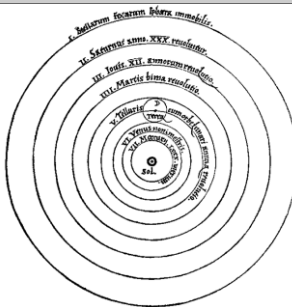
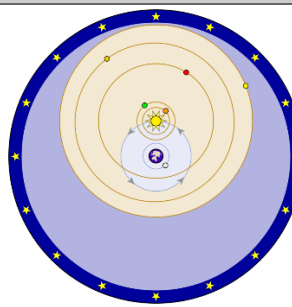
north celestial pole is located near the star Polaris and will be located at the star Vega after 14,000 years.

## Eclipse

Eclipses occur when either the Earth or moon cast a shadow into each other. A solar eclipse occurs when the moon passes between the Earth and sun with the moon casting a shadow on the Earth's surface. A lunar eclipse occurs when the Earth is directly aligned between the sun and moon with the Earth casting a shadow on the moon. Take note that a solar eclipse may occur only during the new moon phase, while a lunar eclipse may occur only during the full moon phase.

## MODELS OF THE UNIVERSE

Throughout the history of astronomy, models of the universe have been projected. The table below describes the model of the universe.

	<b>Ptolemaic system</b>	<b>Copernican system</b>	<b>Tychonic system</b>
Proponent	Claudius Ptolemy	Nicholas Copernicus	Tycho Brahe
Center of universe	Earth	Sun	Earth
Orbits	All other celestial bodies revolve around the Earth.	All planets including Earth revolves around the Sun. Only the moon revolves around the Earth.	The moon and sun revolve around Earth. All other planets revolve around the sun.
Stars	The stars are located and fixed in the outermost celestial sphere.	The stars are located and fixed in the outermost celestial sphere.	The stars are located and fixed in the outermost celestial sphere.
Explanation of retrograde motion	Utilized the epicycles and deferent to explain the apparent westward motion of the planets. (See figure 7a)	Differences in the orbital speed of the planets explained the retrograde motion of the planets. Planets nearer to the Sun revolves faster than those that are far from the Sun.	Same as the Copernican System.
Illustration	 <p>Figure 4 Geocentric model according to Ptolemy  <a href="https://upload.wikimedia.org/wikipedia/commons/8/8f/Ptolemaic_system_%28PSF%29.png">https://upload.wikimedia.org/wikipedia/commons/8/8f/Ptolemaic_system_%28PSF%29.png</a></p>	 <p>Figure 5 Heliocentric model according to Copernicus  <a href="https://commons.wikimedia.org/w/index.php?curid=12353176">https://commons.wikimedia.org/w/index.php?curid=12353176</a></p>	 <p>Figure 6 Geoheliocentric model according to Brahe  <a href="https://commons.wikimedia.org/w/index.php?curid=539033">https://commons.wikimedia.org/w/index.php?curid=539033</a></p>

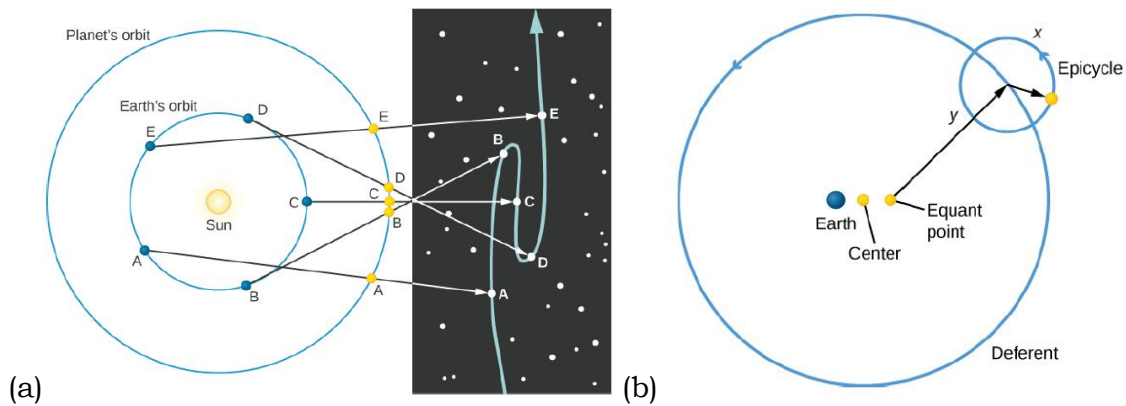


Figure 7 (a) Retrograde motion of Mars as seen in the celestial sphere (b) epicycle used by Ptolemy to explain retrograde motions.

From Ch. 2 Observing the Sky: The Birth of Astronomy—Astronomy (a) p. 47 (b) p.48 | OpenStax. (2016). Download for free at <https://openstax.org/details/books/astronomy>

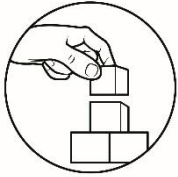
Planets usually rise from east to west as we see in the celestial sphere. However, it was observed by the ancient astronomers that the planets seem to move westward for several weeks and move eastward again in the succeeding weeks. In our current situation, we can explain that these retrograde motions were due to the difference in the period of revolution of the planets around the sun as seen in figure 7a. With Earth being closer to the sun, it moves faster than the planets farther from the Sun. Ptolemy in his time held the belief that the Earth does not revolve and is the center of the universe. The epicycle was used to explain these retrograde motions. Here, a planet revolves in an orbit called epicycle while the center of the epicycle revolves around Earth. This path of revolution of the epicycle is called deferent.

## TYCHO BRAHE AND JOHANNES KEPLER

Tycho Brahe, a Danish astronomer continuously and precisely recorded the position of the sun, moon, and planets for over 20 years using instruments that are like giant protractors. He noted based on his observations that the positions of the planets differ from those that were published. However, he was not able to develop a better model than Ptolemy's as he didn't have the ability to analyze his data. Years before his death, he hired Johannes Kepler as a research assistant to aid in analyzing his data. Brahe was reluctant to provide such data to Kepler, but at his death, the observational data was possessed by Kepler. Being knowledgeable in geometry, Kepler was able to derive from Brahe's data that the orbital path of Mars was elliptical contrary to the previous investigators who were trying to fit the planetary paths in circles. Generalizing his results, he was able to formulate the three laws of planetary motion:

1. *Law of Ellipse: orbits of all the planets are elliptical with the Sun at one focus of the ellipse.* An ellipse is a somewhat flattened circle. It is a closed curve in which the sum of the distances from any point on the ellipse to foci (two points inside) is constant.
2. *Law of Equal Areas: a line joining a planet and the Sun sweeps out equal areas in space in equal intervals of time.* Thus, a planet moves fastest when it is nearest to the sun

3. *Law of Harmony: the square of a planet's orbital period (years) is proportional to the cube of the semimajor axis of its orbit (in astronomical units or AU) or  $P^2 = a^3$ . Thus, the larger the orbit's size, the longer it takes to orbit the sun.*



## What's More

### Activity 1.1 Draw it

Draw a model of the solar system based on the Kepler's Law of Planetary Motions. Write labels and figures to illustrate the three laws.

### Activity 1.2 How far and how many years?

Using the formula given for the Law of Harmony, find the number of years a planet takes to orbit the Sun and its distance from the Sun (semi-major axis).

Ex. Pluto's  $a^3 = 64,000$ . Its distance from the Sun (a) is equal to 40 AU. Likewise, Pluto's  $P^2 = 64,000$ . Its orbital period (P) is equal to 252.98 years.

Planet	Square of planet's orbital years ( $P^2$ )	Cube of the semi-major axis of the planet's orbit ( $a^3$ ) in astronomical units (AU)	Orbital period (a)in years	Distance from the sun (P) in AU
Mercury	0.058	0.058	(1)	(2)

Venus	0.378	0.378	(3)	(4)
Earth	1.00	1.00	(5)	(6)
Mars	3.54	3.54	(7)	(8)
Jupiter	141	141	(9)	(10)
Saturn	868	868	(11)	(12)

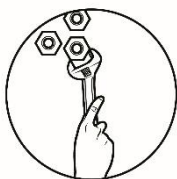


## ***What I Have Learned***

### **Identification**

Identify the astronomical events being described in each item. Write your answer on a separate sheet of paper.

1. It is the daily motion of stars and other celestial bodies across the sky due to Earth's rotation.
2. It is a model which deems Earth as the center of the universe.
3. An event in which the sun passes the celestial equator.
4. Occurs when the moon passes between the Earth and sun with the moon casting a shadow on the Earth's surface.
5. A model which deems all planets revolve around the sun.
6. Set of thirteen constellations seen along the Sun's ecliptic path.
7. The astronomical event in which the sun passes the highest or lowest point from the celestial equator.
8. It is the wobbling of the Earth's celestial north pole.
9. The apparent yearly motion of stars and other celestial bodies across the sky due to Earth's revolution.
10. It occurs when the Earth is directly aligned between the sun and moon with the Earth casting a shadow on the moon.



## ***What I Can Do***

You have learned about the ancient Greek astronomy and the development of the model of the solar system. Answer the questions in two to three sentences.

1. Using a ball and a Frisbee, how would you explain to a flat-earther friend that the Earth is round?

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2. Why was Tycho Brahe's work essential in the development of Kepler's law of planetary motion?



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## **Assessment**

**DIRECTIONS:** Read each question carefully. Choose the letter of the best answer. Write your answer on a separate sheet of paper.

1. Which BEST explains why the Earth is not disk-shaped?
  - A. Stars are viewed differently when traveling north and south.
  - B. The shadow cast by the Earth during a lunar eclipse is circular.
  - C. The shadows cast in two different cities during a solstice differed in length.
  - D. The only shape that cast a circular shadow in whatever direction is a sphere.
2. Which of the following is an annual motion?
  - A. Moonrise
  - B. Eastward rise of stars
  - C. Sunset
  - D. Vernal equinox
3. What astronomical event was NOT known to men before the advent of telescopes?
  - A. Solar eclipse
  - B. Summer solstice
  - C. Retrograde of Mars
  - D. Rotation of the Sun
4. Which aided Eratosthenes in measuring the Earth's circumference?
  - A. The appearance of stars differs as when traveling north and south.
  - B. The shadows cast within the Syene and Alexandria during the solstice.
  - C. The sphere is the only shape that casts a circular shadow in whatever direction.
  - D. The shadow casts by the Earth during a lunar eclipse is circular
- For nos. 5-6, choices are
  - A. Autumnal equinox
  - B. Eastward rise of stars
  - C. Summer solstice
  - D. Zodiac cycle
5. What is a diurnal motion?
6. Which does NOT involve the Sun's ecliptic path?

For nos. 7-10, choices are:

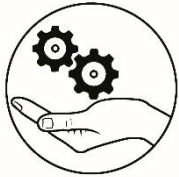
- E. All planets revolve around the sun in an elliptical orbit.
- F. Any point in the closed curved is equidistant to the two foci.
- G. Planets move fastest in the elliptical orbit when nearest to the sun.
- H. The length of a planet's revolution in the Sun is proportional to its orbit's size.

7. Which describes the law of ellipse?
8. Which describes the law of harmony?
9. Which describes the law of equal areas?
10. Which explains the difference in the orbital period of Earth and Saturn?

For nos. 11-15, choices are:

- |               |              |
|---------------|--------------|
| A. Copernican | C. Ptolemaic |
| B. Keplerian  | D. Tychonic  |

11. Which presents a system with elliptical orbit?
12. Which presents a heliocentric model of the universe?
13. Which presents a geo-heliocentric model of the solar system?
14. Which attributes retrograde motion of the planets to epicycles?
15. Which states that a planet moves fastest when it is nearest to the sun?



## ***Additional Activities***

Reflect on your learning in this module using the 3-2-1 questionnaire.

Three things I learned in this module:

1. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
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2. \_\_\_\_\_  
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3. \_\_\_\_\_  
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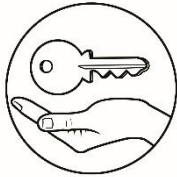
Two things I am interested at:

1. \_\_\_\_\_  
 \_\_\_\_\_  
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 \_\_\_\_\_
2. \_\_\_\_\_  
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One question I still have

1. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Optional: Watch the video on <https://www.youtube.com/watch?v=01QWC-rZcfE> entitled "Cycles in the Sky: Crash Course Astronomy #3", include your learnings from the video in the 3-2-1 questionnaire.



## Answer Key

<p><b>What I have learned</b></p> <ol style="list-style-type: none"> <li>1. diurnal motion</li> <li>2. geocentric model</li> <li>3. equinox</li> <li>4. solar eclipse</li> <li>5. heliocentric</li> <li>6. zodiac</li> <li>7. solstice</li> <li>8. precession</li> <li>9. annual motion</li> <li>10. lunar eclipse</li> </ol> <p><b>Assessment</b></p> <ol style="list-style-type: none"> <li>1. D</li> <li>2. C</li> <li>3. D</li> <li>4. C</li> <li>5. D</li> <li>6. D</li> <li>7. A</li> <li>8. D</li> <li>9. C</li> <li>10. D</li> <li>11. B</li> <li>12. A</li> <li>13. D</li> <li>14. C</li> <li>15. B</li> </ol>	<p><b>What's in?</b></p> <ol style="list-style-type: none"> <li>1. celestial north pole</li> <li>2. celestial south pole</li> <li>3. declination</li> <li>4. right ascension</li> <li>5. ecliptic</li> <li>6. vernal equinox</li> </ol> <p><b>What's more (Activity 1.2)</b></p> <ol style="list-style-type: none"> <li>1. 0.241</li> <li>2. 0.387</li> <li>3. 0.615</li> <li>4. 0.723</li> <li>5. 1.00</li> <li>6. 1.00</li> <li>7. 1.881</li> <li>8. 1.524</li> <li>9. 11.87</li> <li>10. 5.20</li> <li>11. 29.46</li> <li>12. 9.54</li> </ol>	<p><b>What I Know</b></p> <ol style="list-style-type: none"> <li>1. D</li> <li>2. C</li> <li>3. D</li> <li>4. C</li> <li>5. D</li> <li>6. D</li> <li>7. A</li> <li>8. D</li> <li>9. C</li> <li>10. D</li> <li>11. B</li> <li>12. A</li> <li>13. D</li> <li>14. C</li> <li>15. B</li> </ol>
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## References

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**For inquiries or feedback, please write or call:**

Department of Education - Bureau of Learning Resources (DepEd-BLR)

Ground Floor, Bonifacio Bldg., DepEd Complex  
Meralco Avenue, Pasig City, Philippines 1600

Telefax: (632) 8634-1072; 8634-1054; 8631-4985

Email Address: [blr.lrqad@deped.gov.ph](mailto:blr.lrqad@deped.gov.ph) \* [blr.lrpd@deped.gov.ph](mailto:blr.lrpd@deped.gov.ph)