Trippensee® Elementary® Planetarium

653-3030 (M-M10) (unlighted) and 653-3040 (M-M20) (lighted)

Photo shows M-M20 with lighted sun. M-M10 is unlighted

Warranty and Parts:

We replace all missing or defective parts free of charge. For additional parts, use part numbers above. We accept Mastercard, Visa, checks, school P.O.'s. All products guaranteed free from defect for 90 days. This guarantee does not include accident, misuse, or normal wear and tear.

Astronomy models used around the world for almost 100 years!

Introduction

Exciting discoveries and daring adventures continue to focus thinking about our planet Earth, which is, in essence, only a continuously moving speck of dust in the vast regions of space. With the advent of Sputnik in 1957, all the earth, sun, moon and planetary relationships have assumed new importance in our schools as well as in our lives.

Serious study of the planets and stars began long before Sputnik. From the plains of China and India to the mountain valleys of the Andes lie the remains of observatories and religious shrines that were built to study and measure the movements of stars, planets and the moon. More than one ancient and medieval ruler rose to power or stayed in power solely by his ability to predict an eclipse of the sun. Many stone ruins in England and northern France were built to correlate the activities of the sun and moon. In northern Europe the winter solstice was a joyous occasion for at that time the sun had stopped moving southward and was now getting ready to return north to bring forth a new productive season.

In those parts of the world where the skies are not too often overcast and where people's work keeps them outside at night, there has been considerable interest in the heavens. The wandering movements of the planets through the sky, comets and meteors coming and going, the moon constantly changing its shape as well as its time of rising and setting, the sun appearing to move southward in the sky, stop, to come back to the north, stop, and to go south again - all this and much more is easily seen by anyone who takes the time to look.

Because the explanation of so many of these happenings appears complicated, many teachers are hesitant to try to teach them. These planetariums were designed as an economical teaching aid to explain the motions of the earth and moon and other planets and how these motions cause many natural phenomena around us. This manual gives an easy explanation of the more important concepts of the earth in space as taught in astronomy, elementary science, earth science, physical geography and physical science classes. This is followed by a list of individual, group and class activities that will aid in the student's better understanding of our planet.

The Trippensee® planetarium

This planetarium is a manually operated device used to demonstrate some of the real and apparent motions of the sun, earth and moon. The spatial relationship of these celestial bodies with each other and the other members of the solar system are made easier to visualize with the planetarium.

Many of the phenomena observed on the earth caused by the presence of the sun and moon can be explained by using the planetarium to show the interrelation that exists between these objects and the earth.

Description

The planetarium has five (5) main parts. The sun, earth and moon are represented by globes of different sizes. The supporting arm of the instrument is equipped with a compass. The compass is used with the zodiac and calendar found on the base to located objects and positions in the sky.

The sun is the large yellow globe located directly above the base of the planetarium. The earth globe is mounted on the main arm opposite the sun while the moon, also a half white and half black globe, revolves around the earth. Both the earth and moon revolve around the sun when the arm of the instrument is turned.

A list of demonstrations include:

- The reason for the occurrence of night and day
- The variation in the length of day-light
- The moment of the earth around the sun from west to east
- The appearance of midnight sun in the arctic.
- The cause of the seasons
- Why only one side of the moon is seen from the earth
- The cause of phases of the moon
- The occurrence of tides on earth
- How eclipses of the sun and moon occur
- Location of the signs of the zodiac.
- Why the North Star does not change its position in the sky
- How to locate the well-known stars in the sky
- The location of the standard time zones on the earth
- Some difficulties of space travel.

Scale of the planetarium

Great difficulties are encountered in attempting to represent the vastness of the solar system with a reasonable size model. The elementary planetarium shows the relative sizes and distances of the sun, earth and moon only in a general way. For instance, if the whole planetarium were made to the same scale as a 3" earth globe, the sun would be 27' in diameter and 1/2 mile away! If, instead, the planetarium were to be correctly scaled from the 6"sun globe, the earth would be the size of the letter "o" and would be 50' from the sun! Because of the difficulty of showing the exact scale of the celestial bodies, the planetarium represents only relative sizes and distances and some important motions and relationships.

The planetarium is operated by holding the standard in the left hand so that the arm can be turned until it is directly over December 21 on the calendar plate on the base. Now move the entire instrument, without turning the arm, until the compass points north along the arm toward the earth globe. These operations place the planetarium in the proper orientation with respect to space and time (by the stars and the calendar). The planetarium will now correctly show the changing aspects of the planets and the moon when the arm is rotated by grasping the pin below the arm and pushing it in a counter-clockwise direction. This direction of motion causes the arm to pass above the calendar months on the base of the instrument in the proper sequence from December to January and the other months of the year.

The Universe

The universe includes all the things that exist. In astronomy, we are particularly interested in that part of the universe which includes the stars, planets, moon, meteors and comets, and the large groups of millions of stars called galaxies. As new telescopes and other scientific instruments are developed, the "boundaries' of the universe are constantly being pushed farther and farther away. The question of the size and shape of the universe is not yet answered; it remains one of the fundamental problems of astronomy.

New galaxies are constantly being discovered as astronomers continue to study the sky. Our sun is a member of the galaxy known as the Milky Way. The Milky Way is shaped like a large flattened disk with spiral arms radiating out from the center. *See Figure 1.* The sun is located between the outer edge and center of the galaxy. Large clouds of gas and dust called nebulae are found among the stars of the galaxies.

The information about the starts, nebulae, and galaxies is obtained by studying the light emitted by these objects. Giant telescopes are used to observe and photograph the various parts of the sky. Light travels at the fastest know speed, in once second it moves a distance of 186,000 miles, The great speed of light helps us to understand the tremendous separation of the stars and galaxies in the universe. The distance between the sun and the earth is small in comparison to the distance between stars. Yet it takes light from the sun about 8.5 minutes to reach the earth. The speed of light is helpful in measuring large distances. These distances are given in light years, the distance light travels in one year.

Celestial bodies show two basic motions - rotation and revolution. Rotation is the turning or spinning on an axis through the body. Revolution is motion around a point outside the body. The spiral form of many of the visible galaxies indicates that they are rotating around a center common to each of their millions of individual stars. The stars also rotate. Our sun rotates on its own axis and, with the entire solar system, revolves around the center of the Milky Way galaxy. About 800 million years are required for the sun to complete one trip about the center of our galaxy.

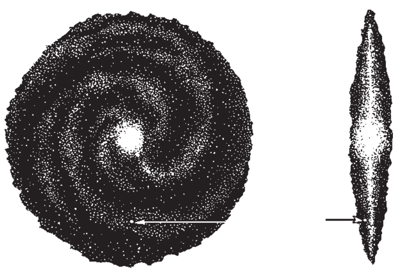


Figure 1

Sun

Our sun is a large globe of hot gas located about 93,000,000 miles from the earth. Compared to other stars it is about average, a yellow star that is common to our galaxy. To the earth, the sun is the most important star in the sky. Its gravity controls the movement of the planets of our solar system and it provides the light and heat necessary for life on earth.

Without the sun's heat, the temperatures on the earth would be so low that life here would not be possible. Without the light from the sun, green plants would not be able to produce the food necessary for most living things to eat.

Solar System

The solar system consists of the sun, the nine principal planets, the moons of the planets, and assorted small bodies including the asteroids, comets and meteors.

Each of the nine principal planets has two basic motions: rotation and revolution. Each rotates on its own axis like a toy top. At the same time, each revolves around the sun. The first motion produces day and night, and the second determines the length of the "year" for each planet.

Degrees and Great Circles

The degree is an important unit of measure used to determine the size of angles. A degree is 1/360 of the total distance around the center of a circle. If the circumference of a circle is divided into 360 equal parts and lines are drawn from the ends of each of these parts to the center of the circle, the angle formed between 2 adjacent pairs of lines is 1°.

A great circle is the largest circle that can be drawn on the surface of a sphere. The center of a great circle is common with the center of the sphere. The earth can be considered a sphere. The earth's equator is a great circle that is located halfway between the poles. Distances along the equator are measured in degrees, 180° east of a starting point and 180° west of the same point, for a total of 360° completely around the equator.

Other great circles are associated with the earth. A line drawn from the north to the south pole and back to the north on the other side of the earth forms a great circle. These circles are called *meridians*. The prime or first meridian goes through Greenwich, England, and ends at N and S poles.

Time

The earth rotates once a day, every 24 hours. It turns through 360° in one rotation. If 24 hours are divided into 360°, you will find that the earth turns through 15° in one hour. This can be checked by multiplying 15° per hour by 24 hours which equals 360°, the angle turned through by the earth in one day. Look on an earth globe or world map. Almost all globes or maps show lines drawn between the poles which represent the meridians. Notice that these lines are spaced 15° apart, that is, they represent locations one hour apart. The area between the lines represent differences in time around the world. There are 24 time zones.

Twelve o'clock noon occurs in a time zone when the sun is directly over one of the 24 standard meridians. A time zone area on the map covers about 7.5° east and 7.5° west of a standard time zone meridian.

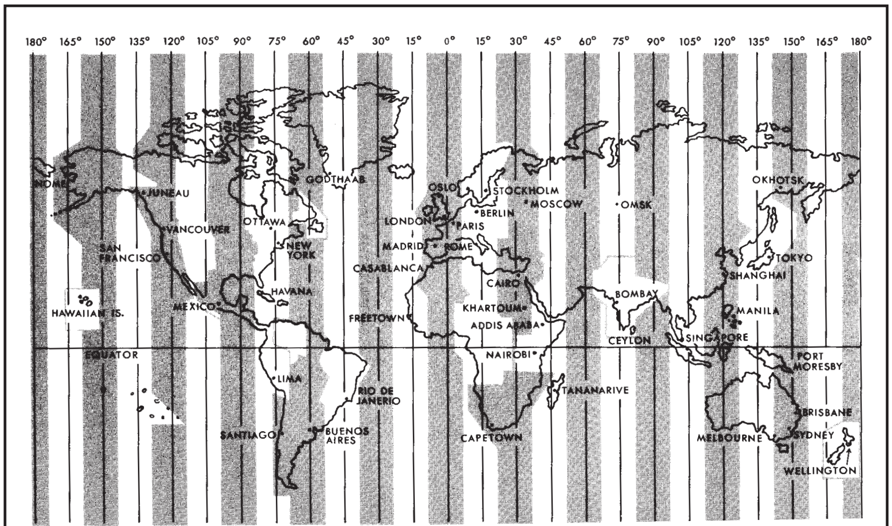
The time is the same throughout the entire time zone which extends from the north to the south pole. A person not moving on the surface of the earth will be carried by the earth's rotation through all the hours and back to his starting point in a twenty-four hour day.

Earth

The earth is one of the 9 principal planets of the solar system, the third from the sun, about 93,000,0000 miles away, revolving between the orbits of Venus and Mars. It is shaped like a sphere that is slightly flat at its poles and bulgy around its equator. The diameter at the equator is 7,920 miles.

The earth has two important motions. It **rotates** once a day (every 24 hours) on its axis, turning from west to east. It **revolves** once a year around the sun, moving in the same direction as its rotation, from west to east. The path of the earth around the sun is its *orbit.*

The planetarium is so constructed as to clearly and unexpectedly show how rotation of a planet or moon occurs. To illustrate, first move the moon around the earth. Notice that the moon both rotates once and revolves once each time it moves around the earth. Now



try the second motion. Hold the base of the planetarium still and revolve the blue arm (and the earth) around the sun. In one revolution of the blue arm, the earth **appears** to rotate once in a clockwise motion. But it does not rotate at all!

Repeat both motions and notice that the moon keeps one face to the earth as it revolves while the earth keeps facing somewhere else and not at the sun. Repeat again while watching the wire supports of the moon and earth. These wire supports also represent the axis of the moon and earth.

As the moon wire is moved around the earth, it both revolves and rotates in the same period of time. Try drawing a circle on a piece of paper with a pencil while keeping one side of the pencil facing the center of that circle. Observe that as the earth revolves around the sun, the earth is not rotating. Now draw another circle without turning or rotating the pencil. Revolve the earth globe again and look at the support wire at the South Pole; no motion is occurring with regard to this support wire and the longitude lines.

With your fingers, turn the earth globe without moving the blue arm. Notice how the earth globe longitude lines move with regard to the supporting wire. Notice that this turning or rotation motion of the earth globe can occur without revolving the earth globe around the sun.

Therefore, it can be seen that rotation and revolution are separate, distinct motions. On the planetarium, the earth globe can show rotation without showing revolution. Accordingly, the earth globe may revolve without showing rotation, even though it **appears** to show one clockwise rotation for every revolution of the blue arm around the sun.

Motorized and synchronized Trippensee® planetariums (**EL-400** and **EL-500)** are constructed to show both rotation and revolution of the earth when the arm is moved around the sun. As a result, these planetarium do not revolve without rotation as does the elementary planetarium.

Motion

Turn the globe of the planetarium until the United States is facing the sun. Notice that the direction of a line from the east coast to the west coast points toward the west. Again turn the globe in the same direction as the line between the coasts - toward the west. This is the direction the earth revolves around the sun. If you look down on the planetarium while the globe is turned, you will see that the earth moves around the sun in the direction opposite to the motion of the hands of clock around its dial. The earth revolves in a counterclockwise direction.

Hold the planetarium above your head so that you are looking up at the south pole. Continue turning the globe in the same direction. The earth now appears to revolve around the sun in the same direction as the hands of a clock. From the south the earth appears to move in a clockwise direction.

Day

The period of time taken by the sun to pass twice over the same meridian circle on the earth is called a solar day. The earth must turn on its axis a little bit more than one complete rotation for the sun to appear again over the same meridian. This can be demonstrated with the planetarium by revolving the earth around the sun and rotating it on its own axis at the same time. The effect can easily be seen by revolving the earth rapidly around the sun while rotating the earth globe slowly on its own axis. The time required for this is almost 4 minutes a day.

Year

The length of a year, the time required for the earth to make one complete revolution around the sun, is nearly 365 1/4 days. The year by the calendar is measured in a whole number of days and is 365 days long. The extra 1/4 day makes it necessary to add one day to the calendar every four years. Thus there are three years of 365 days, each followed by one, "leap year", which has 366 days. If this correction is not made, the seasons would begin one day earlier every four years.

North Star

This planetarium is designed to show the location of the North Star. The earth's axis of rotation points toward a position in space which is very close to the location of the north Star. Turn the arm of the planetarium until it is over December 21 on the Zodiac Plate.

This date is shown by the line separating the seasons of autumn and winter and the zodiac signs Gemini and Cancer. Move the whole planetarium without turning the arm until the compass needle points north over the letter "N" of the compass.

When placed in this position, the compass needle will also be pointing down the arm toward the earth globe. The axis of the earth and its north pole are not pointing toward the North Star.

Notice that when the arm of the planetarium is now turned, while holding the base from moving, the earth's axis continues to point toward the same direction, toward the North Star.

Seasons

Every year the earth makes one complete trip around the sun. During this time the weather changes in a pattern that is repeated each year. The changes in weather are associated with the amount of heat received by different parts of the earth as it travels around the sun.

The year is divided into four periods (seasons) related to the weather changes.

Let's observe the effects caused by the earth's annual revolution.

Spring Equinox (Vernial Equinox)

Turn the arm of the planetarium until it is directly over March 21, the first day of spring. It will be over the line dividing winter and spring on the zodiac plate. The sun appears directly over the earth's equator. The days and nights are the same length - twelve hours each - everywhere on the earth except at the north and south poles.

Summer Solstice

Continue turning the planetarium arm until it is directly over June 21. The sun is not seen directly overhead from positions on the Tropic of Cancer. The Tropic of Cancer is located 23.5° north of the equator. The Arctic Circle is located 23.5° south of the north pole.

Autumnal Equinox

Move the arm slowly toward the month of September. The sun no longer is seen directly over the Tropic of Cancer but moves slowly toward the equator. As on March 21, the sun again appears over the equator, and the daylight and night are each 12 hours long except at the poles. September 23 is usually the first day of autumn, in the northern hemisphere and the first day of spring in the southern hemisphere.

Winter Solstice

Move the arm toward December 21. The sun appears to move from directly over the equator to directly over the Tropic of Capricorn (23.5° south of the equator). The days in the northern hemisphere become shorter until the shortest day of the year - December 21. This is the first day of winter in the northern hemisphere and the first day of summer in the southern hemisphere.

Continue turning the planetarium arm toward March. The sun again appears over the equator and spring has arrived in the northern hemisphere, autumn in the southern hemisphere.

The sun is our most important source of heat and light. The weather in the seasons is about 6 weeks behind the calendar because of the time required for the earth to lose its heat to outer space in the summer and autumn or to gain heat in the winter and spring.

Moon

The moon is our nearest neighbor in space, revolving around the earth as the earth moves around the sun. Even though the moon is much smaller than the earth, it has more influence on the earth than any other celestial body except the sun.

Size and distance

The moon has a diameter of about 2160 miles which is a little more than one-fourth the diameter of the earth. Its average distance from the earth is 238,860 miles. Its path or orbit around the earth is elliptical or egg-shaped.

Rotation

Motions on these planetariums are to be shown separately, by hand. In order to show the phases of the moon it is necessary to move the wire under the moon with your fingers so that the moon's white side is always facing the sun as you rotate it around the earth. (**Note:** The moon is white on the lighted planetarium, Model **M-M20**.)

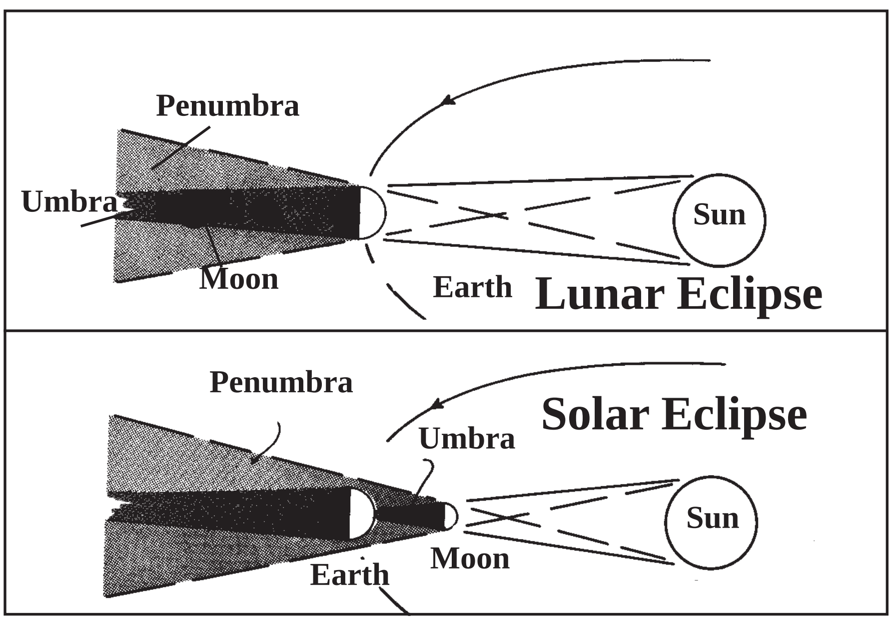
The moon rotates once with respect to the earth every 29.5 days. It rotates once while it revolves once around the earth. *This is why the moon always keeps the same side facing the earth.*

Eclipses

An eclipse can occur 2 ways. The light from the sun is cut off from reaching the earth when the moon passes between the earth and sun. This is called *solar eclipse*. The light from the sun is cut off from reaching the moon when the earth passes between the moon and the sun. This is called *lunar eclipse.* Sometimes only part of the sunlight is prevented from reaching the earth or moon. The eclipse is then called *partial.*

Both types of eclipse are easily demonstrated with the planetarium. The moon can be moved to a position between the earth and the sun to illustrate a solar eclipse. It can also be moved to a position so that the earth globe is between the sun and the moon which illustrates a lunar eclipse.

Between 2 and 5 total solar eclipses occur each year. The number of lunar eclipses varies. The moon may be eclipsed zero, once, or twice a year. The moon's orbit around the earth is tilted 5.25° to the earth's orbit around the sun. This limits the times that the earth and moon may cast shadows upon each other.



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Tides

Twice each day there occurs a rise and fall of the level of the water in the oceans. The water along the coast begins to rise and continues to climb farther upward and inland. This continues for about 6 hours until the highest level is reached. Then the water begins to recede, falling gradually, until it reaches its lowest level about 6 hours later. When the lowest level is reached, the rise begins again. The gradual rise and fall of water level is called the tide. The rising water is the *flood tide,* the falling water the *ebb tide.* Ebb and flood require a period of about 12 hours and 25 minutes so that within 25 hours there are two high, or flood tides, and two low, or ebb, tides.

The tides rise and fall an hour later each day. If it is high tide today at 9 A.M., it will be high tide tomorrow at 10 A.M. High and low tides may occur at any time of the day. Accurate tables of tide schedules have been prepared so the time of the tides can be predicted in different parts of the world. High and low tides occur on opposite sides of the earth at the same time.

Causes of tides

The tides are caused by the gravitational attractions of the sun and moon. The sun's gravitational pull keeps the earth and other planets revolving around it in their orbits instead of flying off into space. The earth's gravitational attraction on the moon holds the moon in its orbit around the earth. The moon also pulls back on the earth. It is the attraction of the sun and moon upon the water in the oceans of the earth that produces the tides. The moon, although very small in size as compared to the sun, has about 2 or 3 times more effect in producing the tides than the sun because it is much closer to the earth.

Spring tides at full moon

Turn the wire support of the moon globe until it is in line with the earth and sun, the earth will be between the sun and moon globes. The gravitational attraction of the sun pulls on the earth in a direction opposite to the gravitational attraction of the moon when the moon is seen as full moon. Since the water on the earth's surface is movable, it will be attracted toward both the sun and moon producing two bulges in the oceans on opposite sides of the earth. High tides occur in the locations where these bulges are formed. The water in the oceans between the high tides moves toward the bulges producing low tides in these locations.

Spring tides at new moon

Turn the wire support of the moon globe until the moon is between the earth and sun. The moon will be seen from the earth as the new moon. When in this position, both the sun and moon are pulling on the earth from the same direction. A high tide appears in the oceans located on the side of the earth which is toward the sun and moon and on the opposite sides of the earth as well. Gravitational attraction between objects depends upon the distance between them. There is a greater gravitational attraction on the water nearest the moon than on the earth as a whole. The earth as a whole is, in turn, more strongly attracted than the water on the side opposite the sun and moon. The earth is effectively being pulled out from under the water on the opposite side, leaving it bulging out as a high tide until the moon moves away from being in line with the earth and sun. The movement away from the water on the opposite side is small; the mid-ocean difference between high and low tide is only about 2 or 3 feet.

Neap tides

At the time of the moon's first and last quarter phases, it is located at right angles to a line between sun and earth. The gravitational attraction of these two objects is also at right angles to each other. Because the effectiveness of the moon in producing tides is greater than the sun, the moon attracts the water on the side of the earth facing the moon and pulls the earth away from the water on the opposite side producing high tides on opposite sides of the earth. The sun is trying to do the same thing. Instead of aiding the moon's effect in producing tides, however, as it does during the new moon, the sun's attraction at right angles to the moon's attraction weakens the effect of producing tides. High tides are produced by the moon but they are not as great as the spring high tides. The smaller tides that occur near the moon's first and last quarter are *neap tides.*

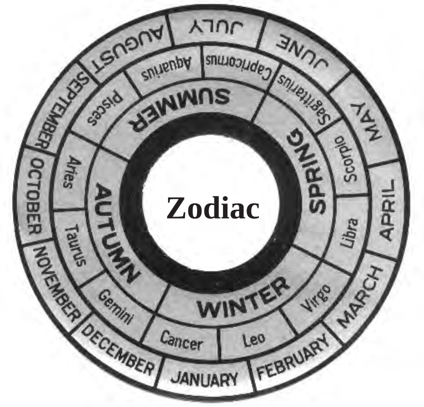
There are slight tides in large inland lakes. In Lake Michigan, at Chicago, the rise and fall of the water is less than 2". Tides may be very high or low where there is a large amount of water into or out of a restricted ocean valley such as the Bay of Fundy, along the coast of New Brunswick and Nova Scotia.

Zodiac

The region in the sky located on either side of the path taken by the sun as it appears to revolve once around the sky in a year is called the zodiac. The sun always appears to rise and set within this region, also known as the belt of the zodiac. The signs of the zodiac are the 12 equal spaces into which the belt of the zodiac is divided. The sun, when viewed from the earth, is always seen in one of the 12 spaces or zodiac signs.

The names of the signs of the zodiac are printed upon the base of the planetarium in the same order as the corresponding signs appear around the belt of the zodiac. They show the directions in which the signs are located in the sky. Notice that the twelve months of the year do not correspond to the twelve signs of the zodiac. The months and signs overlap each other although each of the seasons corresponds to three complete sings of the zodiac.

The proper month of the year, which refers to the position of the earth, is located under the arm of the planetarium while the sign of the zodiac for that month is found on the opposite side of the Zodiac Plate. When the sun is viewed from the earth, it appears to be in the sign of the zodiac which is found on the Zodiac Plate opposite the position of the earth.



General Activities

These activities are not designed for specific grades. Each teacher will be able to choose and adapt those ideas which he feels are best for his particular class. These activities can be done as individual, group or class projects, depending upon the grade level.

1. **Observe the position of the Big Dipper** soon after dark in the evening and again 2 or 3 hours later. Repeat the observations several nights later. Record the time of night and dates when you make each observation and make a star map of that part of the heavens, showing especially the Big Dipper. Notice that the point in the sky about which it appears to turn is marked by a bright but lonesome star (North Star).
2. **If you can obtain an old umbrella, open it up and on the inside paste paper stars to represent the Big Dipper.** Paste a star about the rod or handle where it goes through the umbrella. This will represent the North Star. Turn the umbrella counterclockwise and you can illustrate the apparent motions of the stars. Each complete turn will represent 24 hours. Can you also represent the Little Dipper and Cassiopeia? Turning the umbrella gives the same effect as holding the umbrella over the earth globe on the planetarium and turning the earth globe counterclockwise.
3. **Observe the phases of the moon** over a month's time and record by drawings, dates and observations. How long is a lunar month: This makes a good bulletin board project.
4. **To understand how one star seems to change position against a background of stars**, try the following:

- Hold a finger at arm's length. Close one eye and look at the background. Then close that eye, open the other and again sight at the background. Do not move your finger. Note that the finger seems to "jump."
- Your finger is the "star" whose distance is to be measured. The distance between your eyes creates the same effect as photographing the stars now, then again in 6 months, which is equal to the diameter of the earth's orbit. The "jumping" of your finger corresponds to the star's changed position against a background of other stars.
- This "jumping" or change is called *parallax.*

5. Repeat Activity #4. **Compare the amount of "jump"** when your finger is held at arm's length, about 12" from your eye, and about 3" from your eye. How does this help explain why it is more difficult to measure the distance of more distant stars?
6. On the next clear evening, **locate and observe the Milky Way**. Write a brief description of it. Why is it called the Milky Way? Where is it found in the sky? Include in your report the value of telescopes.
7. On any clear night, **study the stars of the Big Dipper with field glasses.** Record how many "new" stars you can see with the glasses. Locate these stars on a drawing of the Big Dipper and explain why you didn't see them before.
8. **Try your hand at taking star trail pictures.** Most interesting ones will be made by pointing the camera to the north and keeping the shutter open for 3 hours or more.
9. To show the **relative distances of the planets from the sun**, do the following:

- Cut a piece of paper to make a strip 1" wide and 50" long.
- Mark one end and call it the *sun.*
- With a ruler measure 4/16" from the sun and make a mark. Write the name *Mercury* here.
- Make a mark 7/16" from the sun and name this *Venus.*
- At 1" write *Earth.*
- At 1-5/16" write *Mars.*
- At 2-1/2" write *asteroid belt.*
- At 5" write *Jupiter.*
- At 10" write *Saturn.*
- At 20" write *Uranus*
- At 30" write *Neptune*
- At 40" write *Pluto*

10 Underneath this chart, **make another chart making circles with the relative sizes.**

11 As a mathematics project, **figure the relative sizes of the sun, earth, Venus and moon.** Convert relative sizes to inches, using several different scales. Also figure relative distances apart for each scale used. Use the information in Table No. 1.

12 Observe and record **the difference in time that the stars rise each night**.

13 Ideas for individual or group reports:

- Write about each constellation, its history, when seen, how to locate it, important stars in it.
- Write a report on leap year. Historical background on the calendar. The time zones. What time is it elsewhere in the world?
- Write a hypothetical story of a trip to the moon or Venus based on known facts.
- Discuss why scientists planned on trips to Mars or Venus before going to the other planets. (Remember that distance is not the only important issue.)

Table 1 - Day and Night Summary of Seasons

	December 21	March 21	June 21	September 23
North Pole	**24 hrs darkness**	**Twilight**	**24 hrs daylight** (midnight sun)	**Twilight**
Arctic Circle Region	**24 hrs darkness**	**1/2 day, 1/2 night**	**24 hours daylight** (midnight sun)	**1/2 day, 1/2 night**
Tropic of Cancer	--------	--------	**Sun directly overhead**	--------
Equator	--------	**Sun directly overhead**	--------	**Sun directly overhead**
Tropic of Capricorn	**Sun directly overhead**	--------	--------	--------
Antarctic Circle Region	**24 hours daylight** (midnight sun)	**1/2 day, 1/2 night**	**24 hrs darkness**	**1/2 day, 1/2 night**
South Pole	**24 hours daylight** (midnight sun)	**Twilight**	**24 hrs darkness**	**Twilight**

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