

Earth, Moon, and Sun





- 1. The Sky From Earth
- 2. Earth in Space
- 3. Gravity and Motion
- 4. Phases and Eclipses
- 5. Tides
- 6. Earth's Moon

The Big Question



How do Earth, the moon, and the sun interact?

What's happening to the Moon? Page 454



Untamed Science Phased By the Moon



The Sky From Earth



What Can You See in the Night Sky? How Do Objects in the Sky Appear to Move?

My Planet Diary page 458 Watching the Stars



Discuss your answers with a partner



What Can You See in the Night Sky?



On a clear night, you may see stars, the moon, planets, meteors and comets.

Moon

Satellite – is a body that orbits a planet

- 1. Natural Satellite (Moon and Earth)
- 2. Artificial Satellite man made that have been launched from earth.

What Can You See in the Night Sky? Planets

Planets - is an object that orbits the sun, is large enough to have become rounded by its own gravity and has cleared the area of its orbit.



- There are 8 planets
- 5 are visible from Earth without a telescope
- Mercury, Venus, Mars, Jupiter, and Saturn

What Can You See in the Night Sky? Meteors and Comets

Metooroid Netooroid Notice Notice Netooroid Netooroid EARTH EARTH **Meteoroid** - a small body moving in the solar system that would become a meteor if it entered the earth's atmosphere.

Meteor - a small body of matter from outer space that enters the earth's atmosphere, becoming incandescent as a result of friction and appearing as a streak of light Meteorite - a meteor that survives its passage through the earth's atmosphere such that part of it strikes the ground

What Can You See in the Night Sky? Meteors and Comets



Comets - is a cold mixture of dust and ice that gives off a long trail of light as it approaches

Page 459 Figure 1 Observe



What Can You See in the Night Sky? Stars and Constellations

Stars - A giant ball of hot gas, mainly composed of Hydrogen and Helium

Constellations- is a pattern or group of stars that people imagined to represent a figure, animal or object.



Figure 2 Page 460 How to use a Star Chart



Constellations



Southern Horizon

Eastern Horizon

Apply It Page 460

Finding Constellations

What are the names of the constellations in this figure?



Interactive Constellation games





How Do Objects in the Sky Appear to Move?



The apparent motion of objects in the sky depends on the motions of Earth.

Star Motions

The sun's apparent motion during the day is also caused by Earth's motion.

Figure 3 Page 462

Opposite Motions

Where would the mountain appear at each time shown?



Opposite Motions



Seasonal Changes



- Constellations and star patterns remain the same year after year, but which ones you can see varies from season to season.
- These are caused by Earth's orbit around the sun
- There are a few constellations that you can see all years long,
- These are the ones closest to the North Star.
- These constellations never appear to rise or set.



- The appear to move against the background of stars
- Because the planets all orbit the sun in about the same plane, they appear to move through a narrow band in the sky.
- This band is called the zodiac.
- It includes constellations such as Taurus, Leo and Virgo

Figure 4 Tracking the Planets Page 463

Assess Your Understanding Page 463

岩**山** Zone

Materials

Star chart chart paper

2 sheets markers

Your Questions will be on Google Classroom

Watching the Skies

Stars and planets appear to change position over time as you view them from Earth. Some of these motions are real. Others are apparent motions caused by Earth's rotation and revolution.

Procedure

- 1. Use the star chart to locate the constellations Leo and Pegasus. Draw each constellation on a separate sheet of chart paper.
- 2. Have two students in your group each take a drawing. These two students should stand on opposite sides of the room. A third student should stand between them to represent the sun.
- 3. Stand about 1.5 m from the "sun," facing the drawing of Leo. Slowly move clockwise around the "sun," always facing away from the "sun." Observe how your view of the constellations changes.
- 4. Trade places with the other students in your group and repeat Steps 2 and 3 until everyone in the group has observed the constellations.

- 1. The moon is Earth's only natural
 - A . zodiac
 - B. meteor
 - C. comet





2. A planet is large enough to have been rounded by its



- A. rotation
- B. gravity
- C. moon
- D. orbit

3. You can match constellations to your location and the season using a

- A. GPS receiver
- B. star chart
- C. horoscope
- D. telescope

D.

4. Planets appear to move against the background of

- A. other planets
- B. other planets' moons
- C. the sun
 - stars

Review

The Sky From Earth

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.



Orbit around 5. the sun Earth's rotation on its axis causes seasonal changes in the constellations you can observe.



____Stars are made up mainly of hydrogen and

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

7. <u>Different</u> Different cultures have identified the same constellations.



8. <u>Saturn</u> You can see five planets from Earth without a telescope: Mercury, Venus, Mars, Jupiter, and <u>Uranus</u>.

9. _____The <u>actual</u> motion of objects in the sky depends on the motions of Earth.





Earth in Space



How Does Earth Move? What Causes Seasons?

My Planet Diary page 464 The Seasons



Discuss these questions with your group



1.

What Causes Day and Night?

How Does Earth Move?



Earth moves in space in two major ways: Rotation and Revolution

Axis - the imaginary line that passes through Earth's center and the north and South Poles.



Rotation - the spinning of Earth on its axis

Rotation Figure 1 page 465



Earth's Rotation In which direction does the Earth rotate?



Revolution



Revolution - the movement of one object around another.

Orbit - Earth path, slightly elongated circle or ellipse. It is the closest to the sun in January.



Figure 2 Page 464 Revolution and Rotation

Calendars

Calendar - a system of organizing time that defines the beginning, length, and divisions of a year.

Assess Your Understanding page 467



What Causes Season?



- Many places that are far from Earth's equator and its poles have four distinct seasons: winter, spring, summer, and autumn.
- But there are differences in temperature from place to place.
- It is generally warmer at the equator than near the poles. Why?

How Sunlight Hits Earth

The diagram shows how Earth's tilted axis affects the strength of sunlight in different places.

Draw a circle around the area where sunlight is most direct. Mark an X on the places that sunlight reaches, but where it is less direct.

Page 468



Earth's Tilted Axis



Earth has seasons because it axis is titled as it revolves around the sun.

- If Earth's axis were straight up and down relative to its orbit, temperatures i an area would remain fairly constant year-round.
- There would be no seasons!!

Earth's Tilted Axis

March June December September

The Earth's axis is always tilted at an angle of 23.5 from vertical.

The North Pole always points in the same direction.

Earth's Tilted Axis

March June December September

June the north end of Earth's axis is tilted toward the sun.

December the north end of the Earth's axis is tilted away from the sun.

Summer Solstice

Solstices - the days that sun appears farthest north of the equator once each year and farthest south once each year

- June 21st the longest day of the year Summer solstice
- December 21st the shortest day of the year winter solstice.



Equinoxes

Equinox - Equal Day and Night

- Halfway between the solstices, neither hemisphere is tilted toward the sun.
- Each day and night are each about 12 hours long everywhere.
- Spring (Vernal) equinox occurs around March 21
- Fall (Autumnal) equinox occurs around September 22

Figure 5 Page 470



The diagrams show the apparent path of the sun at the solstices and equinoxes in the Northern Hemisphere. What is the sun's path at the equinoxes and the December solstice for the Southern Hemisphere?

Draw the sun's path at s the equinoxes and the December solstice for the Southern Hemisphere.

Solstices and Equinoxes Page 470


Do The Math page 471

Calculating Percents The table shows the number of hours of sunlight in three cities at different times of year.

Assess Your Understanding Page 471

City	Approximate Latitude	Hours of Daylight			
		January 1	April 1	July 1	October 1
Helsinki, Finland	60°N	5.98	13.33	18.80	11.45
Philadelphia, United States	40°N	9.38	12.68	14.95	11.77
Guadalajara, Mexico	20°N	10.90	12.37	13.37	11.95

Reason for the Seasons





Reason for the Seasons

Season and Earth Revolution

- **1.** Earth is closest to the sun when it is summer in the
- A Southern Hemisphere
- **B** Northern Hemisphere
- C Western Hemisphere
- D Eastern Hemispher.

- **2.** When it is summer in the Southern Hemisphere, it is winter in the
- A equator
- **B** Northern Hemisphere
- C Western Hemisphere
- D Eastern Hemisphere

3. In June, there are fewer hours of daylight and less direct sunlight in the A Southern Hemisphere
B Northern Hemisphere
C Western Hemisphere
D Eastern Hemisphere

4. Each of the two days of the year when neither hemisphere is tilted toward or away from the sun is called a(n)A winter solstice

- B summer solstice
- C rotation
- D equinox

Fill in the blank to complete each statement.

5. Earth haseasons because its axis is tilted as it revolves around the sun.

6. Earthristation causes day and night.

Fill in the blank to complete each statement.

7. Earth's orbit is a slightly elongated circle, or ellipse.

8. One revolution of Earth around the sun is called a(n)<u>year</u>

Fill in the blank to complete each statement.

9. The most common lendar in use today is divided into years, months, and days.
10. The union occurs around March 21 in the Southern Hemisphere.



Gravity and Motion



My Planet Diary page 472 Gravity Assists



Discuss these questions with your group



岩**山** ZONE

What Factors Affect Gravity?

Gravity is a force that attracts all objects toward each other. In this activity, you will graph some data to explore two factors that affect the force of gravity.

Pick up a handout

Materials Graph paper Color Pencils

- **1.** The table shows the approximate force of gravity experienced by two space probes approaching Mars. Probe 2 has twice the mass of Probe 1
- 2. Use the data in the table to create a double-line graph. First, label the axes.
- **3.** Plot one point for each data point given in the table. Use one color to represent Probe 1 and another color to represent Probe 2. Make a key showing which color represents each probe.
- 4. Connect the points for each probe with a curved line





Gravity - the force that attracts all objects toward each other.

Law of Universal Gravitation - states that every object in the universe attracts every other object.



The strength of the force of gravity between objects depends on two factors: the masses of the objects and the distance between them.

Gravity, Mass, and Weight

The strength of gravity depends in part of the masses of each of the objects

Mass - is the amount of matter in an object.

My WEIGHT

on the moon

is around

90N

My WEIGHT on

Earth is around

560N

My MASS is

always 56kall

• Earth is so massive, it exerts a much greater force on you than a book.

Weight - the measure of the force of gravity on an object.

• Mass doesn't change, weight does depending on the location.

Gravity and Distance



- Gravity is also affected by the distance between two objects.
- The force of gravity decrease rapidly as distance increases
- If the distance between 2 objects doubles, the force of gravity decreases to one fourth of its original value.

Gravity, Mass, and Distance

Compare and contrast the force of gravity in the second and third pictures.

What Keeps Objects in Orbit?

If the sun and Earth are constantly pulling on one another because of gravity, why doesn't Earth fall into the Sun? And why doesn't the moon crash into Earth? The fact that such collisions have not occurred shoes that there must be another factor at work. That factor is called......





Inertia

Inertia - the tendency of an object to resist a change in motion.

- You feel the effects of inertia everyday. (No seatbelts)
- The more mass an object has, the greater its inertia
- An object with greater inertia is more difficult to start or stop

Newton First Law of Motion - that an object at rest will stay at rest and an object in motion will stay in motion with a constant speed and direction unless acted on by a force

Orbital Motion



Figure 2 page 474

How would the moon move if Earth's mass increased? Newton concluded that inertia and gravity combine to keep Earth in orbit around the sun and the moon in orbit around the Earth.



Do The Math Page 475

Gravity Versus Distance

As a rocket leaves a planet's surface, the force of gravity between the rocket and the planet changes.

Assess your Understanding

of Gravity on the Rocket 3 (million newtons) 2 Surface of Force planet 0 2 3 0 **Distance From Planet's Center** (planet's radius = 1)

Gravity and Distance

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Materials 24

large washers

string

meter stick

scissors

Around and Around We Go

Earth, its moon, and all of the other objects in our solar system stay in their orbits as the result of inertia and gravity. In this activity, you will explore some of the factors that affect an object's orbit.

Procedure

1. Make a group of four washers. Tie one end of the string around the washers. *Note: Make sure the knot is secure.*

2. Measure 50 cm of string, starting at your knot. Cut the string.

- 3. Repeat Steps 1 and 2 using a group of 20 washers.
- **4.** Put on your safety goggles. Wrap the string with four washers around a couple of your fingers and hold it above your head. Swing the string until the washers move in a horizontal circle above your head. Notice how much the string tugs on your fingers. Let your partner swing the string.
- **5.** Repeat Step 4 using the other string. Try to move the washers at the same <u>speed as in Step 4</u>.

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

. Newton's first law of <u>inertia</u> says that an object at rest will stay at rest and an object in motion will stay in motion unless acted on by a force.

2. Inertia and <u>distance</u> combine to keep Earth in orbit around the sun and the moon in orbit around Earth.

3. Newton's law of <u>planetary</u> gravitation states that every object in the universe attracts every other object.

4. Gravity decreases to <u>one fourth</u> of its original value if the distance between two objects doubles.

Inward

tward

5.

Earth's gravity pulls the moon

Fill in the blank to complete each statement.

6. The amount of matter in an object isnitess

Gravity7. ______ attracts all objects toward each other.

inertia **8.** An object with greater ____ is more difficult to stop or start.____

Fill in the blank to complete each statement.

9. The see of two objects and their distance from each other determine the gravitational force between them.

Weight.

10. The measure of force on an object is its



Phases and Eclipses



What Causes the Moon's Phase? What Are Eclipses?

My Planet Diary page 476

Discuss these questions with your group



What Causes the Moon's Phases?



- The moon light you see if the reflection of the sunlight
- The moon does not emit its own light.

Phases - The different shapes of the moon you see from Earth

Motion of the Moon

- When you look at the moon you see the same pattern all the time. Why?
- The same side of the moon, the "near side," always faces Earth.
- How? Like Earth the Moon revolves in 2 ways rotates and revolves.
- The moon rotates once on its axis i the same time that it take to revolve once around Earth around.
- A day on the Moon is the same length as a month on Earth.



The Moon's Motion

Where would the moon's face appear in each view in this diagram that shows the moon's rotation and revolution?



Figure 1 Page 477

How would the moon appear from Earth if the moon did not rotate?

Phases of the Moon



- Half the moon is always in sunlight,
- The phase of the moon you see depends on how much of the sunlit side of the moon faces Earth.
- About 29.5 days after the last new moon, a new moon occurs again.
- Figure 2 Page 478
- Assess Your Understanding

Moon Phases

Moon Phase Flip Book





What Are Eclipses?

- The moon's orbit around Earth is slightly tilted with respect to Earth's orbit around the sun.
- As a result, the moon travels above and below the Earth's orbit.
- But on rare occasions, Earth, the moon, and the sun line up.

Eclipse - when an object in space comes between the sun and a third object, it cast a shadow on that object.

2 types of eclipse - Solar (sun) and Lunar (moon)



Solar Eclipses

Solar Eclipse - occurs when the moon passes directly between Earth and the sun, blocking sunlight from Earth.

The moon's shadow then hits Earth.







Solar Eclipses - Total

Umbra - the very darkest part of the moon's shadow. Only people in the umbra can experience a total eclipse.

• It get dark, cold and you can see the stars and the solar corona.





Solar Eclipses - Partial

Penumbra - the larger part of the shadow that the moon cast that is less dark.

Figure 3 Page 479





Lunar Eclipse



Lunar Eclipse - occurs at a full moon when the Earth is directly between the moon and the sun.



During a lunar eclipse, Earth blocks sunlight from reaching the moon.



Lunar eclipse occurs only when there is a full moon because the moon is closest to Earth's shadow at that time.

Put an X on the total lunar eclipse

Lunar Eclipse Total

- Earth shadow has an umbra and a penumbra.
- In the umbra you will see a total eclipse and a partial in the penumbra
- It is visible anywhere on Earth


Lunar Eclipse - Partial

- For most lunar eclipses, Earth, moon and the sun are not quite in line and only a partial will result.
- Occurs when passes partly into the umbra of Earth's shadow



Seasons and Shadows

How do Earth, the moon, and the sun interact?



Eclipses Interactive On Pearson and Active Folders in the back

Assess Your Understanding page 481

1. A solar eclipse occurs when the moon

- A passes into the penumbra of Earth
- B passes into the umbra of Earth
- C passes at a slight tilt between Earth and the sun
- D passes directly between Earth and the sun

- **2.** When Earth is directly between the moon and the sun,
- A a total solar eclipse occurs
- B a lunar eclipse occurs
- C a partial solar eclipse occurs
- D the penumbra of the moon shrivels

- **3.** _As the moon moves through Earth's shadow,
- A a lunar eclipse occurs B the phases of the moon occur C a solar eclipse occurs D a new orbital path is formed

4. Like Earth, the moon rotates and

A waxes

B goes through a cycle of phases each month





Review Changes in Communities

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

5. Phases <u>Crescents</u> are the different shapes of the moon you see from Earth.

6. Rotates The moon revolves around Earth and revolves on its own axis.

7. One "day" on the moon is the same length as one month on Earth.

Review Changes in Communities

8. As the moon orbits Earth, the absolutive positions of the moon, Earth, and the sun change.

9. The moon's orbit around Earth is absolgtely sitesight with respect to Earth's orbit around the sun.



The amount of the moon's surface that

Lesson 5





What Are Tides?

My Planet Diary page 482 A River in Reverse



Discuss these questions with your group



What Are Tides?

Tides - The rise and fall of ocean water that occurs every 12.5 hours.

The water rises for about 6 hours and then falls about six hours.



The Tide Cycle



Tides are caused mainly by difference in how much gravity from the moon and the sun pulls on different parts of Earth.

At anyone time on Earth, there are two places with high tides and two places with low tides.



Tides Page 483



Figure 1 Page 483

Write an H where high tides occur and an L where low tides occur. **Near Side** - The moon's gravity pulls a little more strongly on the water on the side closest to them moon than on Earth as a whole.

Far Side - The moon's gravity pulls more weakly on the water on the far side of Earth than on Earth as a whole

North Pole

Tides Page 483



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North Pole

The Sun's Role

quarter moon phase

neap tides

spring tides

sun

New Moon is directly in line with the Sun and Earth, the gravity of the sun and moon pull in the same direction.

Spring Tide - Their combined forces produce a tide with the greatest difference between consecutive low and high tides.

During the moon's 1st quarter phase the line between Earth and sun is at right angles to the line between Earth and moon.

Neap Tide - a tide with the least difference between consecutive low and high tides. Occurs twice a month



The Sun's Role

Changes in the positions of Earth, the moon, and the sun affect the heights of the tides during a month. What is the position of the moon and the tide bulges at third quarter?

Draw the position of the moon and the tide bulge at third quarter. What kind of tide occurs?



Apply It page 485

High and Low Tides at St. John, New Brunswick

Date	High Tide (meters)	Low Tide (meters)
May 6–7	8.7	0.0
May 13–14	7.1	1.7
May 21	7.5	1.2
May 26	6.9	2.0

High and Low Tides The table shows high and low tides at four times in May 2008, in St. John, New Brunswick.

- 1. Spring tides occurred at two of the times show. Which two? How do you know?
- 2. Would the tide be higher than the moon is on the same side of Earth as New Brunswick or on the opposite side? Why?

Assess Your Understanding Page 485



Neil DeGrasse Tyson



Materials

round balloon colored pencils

Modeling the Moon's Pull of Gravity

Tides are caused mainly by differences in how much the moon's gravity pulls on different parts of Earth. In this activity, you will model effects of the moon on Earth's tides.

- **1.** Blow into the balloon until it is a little more than half full of air. Tie a knot in the neck of the balloon.
- 2. Have your partner hold the balloon firmly in his or her palm.
- **3.** Gently pull on the knotted end of the balloon without pulling it out of your partner's hand and observe any changes in the shape of the balloon

Modeling the Moon's Pull of Gravity

- 1. What represents Earth in this model?
- 2. What does pulling on the balloon represent in this model?

3. Use the colored pencils to draw and label your model as it appeared in Step 3. Your labels should include *Earth*, *the moon*, *high tides*, and *low tides*.

1. The bulge of water on the side of Earth closest to the moon produces



- 2. Water flows toward the high tides, halfway between them causing
- A low tides
 - B neap tides
 - C high tides
 - D rip tides

3. Tides are the cycle of rising and falling ocean water that repeats approximately



- A every 24 hours
- B every 12.5 hours
- C every 25 hours
- D every 6.25 hour

- 4. A spring tide can occur
- A in any month after March
- B in March, April, or May
- C in late February-early June
- D in any month of the year

Roview **Tides**

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

5. Least A neap tide has the greatest difference between consecutive low and high tides.

6. Twice

7. full

Neap tides occur once a month.

Spring tides are produced during a new moon and crescent moon.



10.Tides are caused mainly by differencesin how much gravity from the moon and the sun pulls ondifferent parts of Earth.







What Is the Moon Like?

My Planet Diary page 486 Galileo Galilei

Discuss these questions with your group

I have been led to that opinion ... that I feel sure that the surface of the Moon is not perfectly smooth ... but that, on the contrary, it is ... just like the surface of the Earth itself, which is varied everywhere by high mountains and deep valleys.

What Are Tides?



The Tide Cycle



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Tides Page 483



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Review Tides

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