#### **Astronomy**



"Actually they all look alike to me."



Earth's Motions (Verbal Quiz 1-7)	Rotation	Revolution		
Definition				
What is the direction of movement?				
How long does it take?				
What is the rate?				
Result of the motion				
How can you prove this motion?	Two Ways:			



### 1) Foucault Pendulum









# Foucault Pendulum Coriolis Effect

http://highered.mcgraw-hill.com/sites/dl/free/0072482621/59233/8\_6.htm

#### **Earth's Revolution around the Sun**

#### - Slightly eccentric elliptical orbit



#### **Earth's Revolution around the Sun**

- Slightly eccentric elliptical orbit

Earth is moving around the Sun at about 67,000 miles per hour.



### 1) Changing Constellations

http://highered.mcgraw-hill.com/sites/dl/free/0072482621/59233/2.htm



Copyright © 2005 Pearson Prentice Hall, Inc.

### Vicience for Revolution 1) Changing Constellations 2) Doppler Shift

OBJECT RECEDING: LONG RED WAVES



OBJECT APPROACHING: SHORT BLUE WAVES

#### **Earth's Motions**

How long is one rotation of Earth? 1 day (24 hours)

How long is one revolution of Earth? **1 year (365 days)** 



#### For each of the following events state whether it is caused by the Earth's rotation or revolution:

**Rising and setting of the sun:** Rising and setting of the moon: The seasons: **Changing Constellations:** Movement of Stars through the sky:

#### Rotation Rotation **Revolution** Revolution Rotation

#### Show how to calculate the Earth's rate of rotation in degrees per hour.

#### One rotation = 360 °

#### Time for one rotation = 24 hours

#### 360 ° / 24 hours = 15 ° / hour





How many degrees did the stars move 60n(2lagram/15) diagram 2?



#### It's the only one that How can you find Cheft moye Polaris?



What Rithsphere Becanas Rydatis Gan only been sequin the North



#### What direction must you be looking?



#### What direction do the stars appear<sup>Counter -</sup> to Clockwise move?

#### EARTH'S ROTATION

### What causes the stars appear to move?





#### **Satellites**

### Satellite – Any object in space moving in orbit around another object

Earth is a satellite of the \_\_\_\_\_

The moon is a satellite of **earth** 

Why do the distances between the sun and earth change?

#### **Because Earth's orbit is elliptical (oval shaped)**

https://video.yahoo.com/harry-caray-spaceinfinite-frontier-000000505.html

### The Moon





#### Formation of Earth's Moon



#### Have you heard of the face on the Moon





#### Phases of the Moon

- 1) The apparent shape of the moon depends on the changing positions of the <u>Sun</u>, <u>Earth</u> and <u>Moon</u>.
- 2) How long does it take the moon to revolve around the Earth? **1** month
- 3) One complete orbit of the moon around the Earth takes about **271/3** days
- 4) A complete cycle the moon's phases takes **29 ½ days**

5) Explain why there is a 2 ½ day difference between the revolution of the moon and the amount of time it takes to complete all of its phases.

As the moon is taking 27 1/3 days to revolve around Earth, Earth is also revolving around the sun. It takes an additional 2 days for the Earth, Sun and Moon to align and complete all of its phases.



How long does one revolution of the moon take? 27.3 days How long does one rotation of the moon take?

Solar System Data											
Object	<b>Mean Distance</b> <b>from Sun</b> (millions of km)	Period of Revolution	Period of Rotation	Eccentricity of Orbit	Equatorial Diameter (km)	<b>Mass</b> (Earth = 1)	<b>Density</b> (g/cm <sup>3</sup> )	Number of Moons			
SUN	_	_	27 days	_	1,392,000	333,000.00	1.4	_			
MERCURY	57.9	88 days	59 days	0.206	4,880	0.553	5.4	0			
VENUS	108.2	224.7 days	243 days	0.007	12,104	0.815	5.2	0			
EARTH	149.6	365.26 days	23 hr 56 min 4 sec	0.017	12,756	1.00	5.5	1			
MARS	227.9	687 days	24 hr 37 min 23 sec	0.093	6,787	0.1074	3.9	2			
JUPITER	778.3	11.86 years	9 hr 50 min 30 sec	0.048	142,800	317.896	1.3	16			
SATURN	1,427	29.46 years	10 hr 14 min	0.056	120,000	95.185	0.7	18			
URANUS	2,869	84.0 years	17 hr 14 min	0.047	51,800	14.537	1.2	21			
NEPTUNE	4,496	164.8 years	16 hr	0.009	49,500	17.151	1.7	8			
PLUTO	5,900	247.7 years	6 days 9 hr	0.250	2,300	0.0025	2.0	1			
EARTH'S MOON	149.6 (0.386 from Earth)	27.3 days	27 days 8 hr	0.055	3,476	0.0123	3.3	—			

## What phenomenon does this explain?

### We only ever see off side of the moon,





#### **Important Vocabulary**

**New Moon:** Occurs when the moon is between the earth and the sun. You can not see the moon.

\* However you can see moon because moons orbit of earth is tilted 5 degrees compared to Earth's orbit.


#### **Full Moon:** Occurs when all the moons surface facing earth reflects light. You see all of the moon.



**Waning:** The decreasing of the visible amount of the moons surface, from full moon to new moon.

**Waxing:** The increasing of the visible amount of the moons surface, from new moon to full moon



**<u>Gibbous:</u>** A phase of the moon that is between full and quarter phase, you see more of the moon.



**<u>Crescent:</u>** A phase of the moon that is between a quarter moon and a new moon, you see less of the moon.



#### <u>http://www.sumanasinc.com/webcontentsinc.com/webcontentsint/anisamples/astronomy/moonphase.h</u> tml





Convright © 2005 Pearson Prentice Hall Inc.



# The phases of the moon are what type of event?

Cyclic













Tides

#### - The rising and falling of the ocean surface.

- Change in tide is the result of the changing positions of the Moon, and Sun relative to Earth.

- Close to 2 high tides and 2 low tides per day

#### What Causes Tides

Caused by the gravitational pull of the moon & sun

#### Based on the Diagram, which are larger?





# During which phases of the moon



# CO neap and spring



# Neap?

#### 





### 

Spring Tide:

- Occurs when the Moon and Earth are aligned in a straight line with the sun.

- Highest of the high tide and lowest of the low tide

**NeapTide:** 

- Occurs when the Moon and Earth are at right angles with the sun.

- Lowest of the high tide and highest of the low tide





#### What's the difference between solar and lunar eclipses?







Earth goes into moon's shadow.

Moon goes into Earth's shadow

#### SOLAR ECLIPSE

- Occurs when the moon is in the New Moon Phase
- Moons shadow moves over the Earth's surface, and you can't see the sun. (Sun, Moon, Earth,) (SME)
- Eclipse occurs where the point of the shadow hits Earth's surface

#### <u>Solar</u> Eclipse

#### What phase?

### New Moon

http://www.bbc.co.uk/science/space/solars ystem/sun/solareclipse.shtml

#### **Total Solar Eclipse**



4/23/2018

#### LUNAR ECLIPSE

- Occurs when the Moon is in the Full Moon phase

- The moon moves into Earth's shadow. (Sun, Earth, Moon) (SEM)

- Lasts until the moon moves out of Earth's shadow.

#### Lunar Eclipse

# What phase?

http://www.classzone.com/books/earth\_sci ence/terc/content/visualizations/es2504/es 2504page01.cfm?chapter\_no=25





#### Lunar Eclipse





In order to have a solar eclipse, what phase must the moon be in?

In order to have a lunar eclipse, what phase must the moon be in?

Why don't we have solar and lunar eclipses every month?

### The moons orbit around Earth is tilted about 5 degrees

**New Moon** 

**Full Moon** 





Lunar Eclipse (SEM)



Solar Eclipse (SME)

## Our Solar System



# The Planets




## **Terrestrial vs. Jovian Planets**

#### **Terrestrial**

-Closer to the sun - Mostly Solid

- Smaller with high densities

<u>Jovian</u>

- Far from sun
- -Gaseous
- Larger with low densities



#### **Reference Table Page 15**

Solar System Data

Object	<b>Mean Distance</b> <b>from Sun</b> (millions of km)	Period of Revolution	Period of Rotation	Eccentricity of Orbit	Equatorial Diameter (km)	<b>Mass</b> (Earth = 1)	<b>Density</b> (g/cm <sup>3</sup> )	Number of Moons
SUN	_	_	27 days		1,392,000	333,000.00	1.4	_
MERCURY	57.9	88 days	59 days	0.206	4,880	0.553	5.4	0
VENUS	108.2	224.7 days	243 days	0.007	12,104	0.815	5.2	0
EARTH	149.6	365.26 days	23 hr 56 min 4 sec	0.017	12,756	1.00	5.5	1
MARS	227.9	687 days	24 hr 37 min 23 sec	0.093	6,787	0.1074	3.9	2
JUPITER	778.3	11.86 years	9 hr 50 min 30 sec	0.048	142,800	317.896	1.3	16
SATURN	1,427	29.46 years	10 hr 14 min	0.056	120,000	95.185	0.7	18
URANUS	2,869	84.0 years	17 hr 14 min	0.047	51,800	14.537	1.2	21
NEPTUNE	4,496	164.8 years	16 hr	0.009	49,500	17.151	1.7	8
PLUTO	5,900	247.7 years	6 days 9 hr	0.250	2,300	0.0025	2.0	1
EARTH'S MOON	149.6 (0.386 from Earth)	27.3 days	27 days 8 hr	0.055	3,476	0.0123	3.3	—

meteor A streak of light in the sky that occurs when a meteoroid enters Earth's atmosphere "shooting star"



# Comets - Huge dirty ice ball that revolves around the sun.

- When close enough to sun, exhibits a tail



#### **Reference Table Page 15**

Solar System Data

Object	<b>Mean Distance</b> <b>from Sun</b> (millions of km)	Period of Revolution	Period of Rotation	Eccentricity of Orbit	Equatorial Diameter (km)	<b>Mass</b> (Earth = 1)	<b>Density</b> (g/cm <sup>3</sup> )	Number of Moons
SUN	_	_	27 days		1,392,000	333,000.00	1.4	_
MERCURY	57.9	88 days	59 days	0.206	4,880	0.553	5.4	0
VENUS	108.2	224.7 days	243 days	0.007	12,104	0.815	5.2	0
EARTH	149.6	365.26 days	23 hr 56 min 4 sec	0.017	12,756	1.00	5.5	1
MARS	227.9	687 days	24 hr 37 min 23 sec	0.093	6,787	0.1074	3.9	2
JUPITER	778.3	11.86 years	9 hr 50 min 30 sec	0.048	142,800	317.896	1.3	16
SATURN	1,427	29.46 years	10 hr 14 min	0.056	120,000	95.185	0.7	18
URANUS	2,869	84.0 years	17 hr 14 min	0.047	51,800	14.537	1.2	21
NEPTUNE	4,496	164.8 years	16 hr	0.009	49,500	17.151	1.7	8
PLUTO	5,900	247.7 years	6 days 9 hr	0.250	2,300	0.0025	2.0	1
EARTH'S MOON	149.6 (0.386 from Earth)	27.3 days	27 days 8 hr	0.055	3,476	0.0123	3.3	—

#### Draw a line across the table between the terrestrial and jovian planets and label.

Solar System Data										
Object	Mean Distance from Sun (millions of km)	Period of Revolution	Period of Rotation	Eccentricity of Orbit	Equatorial Diameter (km)	<b>Mass</b> (Earth = 1)	<b>Density</b> (g/cm <sup>3</sup> )	Number of Moons		
SUN			27 days		1,392,000	333,000.00	1.4	_		
MERCURY	57.9	88 days	59 days	0.206	4,880	0.553	5.4	0		
VENUS	108.2	224.7 days	243 days	0.007	12,104	0.815	5.2	0		
EARTH	149.6	365.26 days	23 hr 56 min 4 sec	0.017	12,756	1.00	5.5	1		
MARS	227.9	687 days	24 hr 37 min 23 sec	0.093	6,787	0.1074	3.9	2		
JUPITER	778.3	11.86 years	9 hr 50 min 30 sec	0.048	142,800	317.896	1.3	16		
SATURN	1,427	29.46 years	10 hr 14 min	0.056	120,000	95.185	0.7	18		
URANUS	2,869	84.0 years	17 hr 14 min	0.047	51,800	14.537	1.2	21		
NEPTUNE	4,496	164.8 years	16 hr	0.009	49,500	17.151	1.7	8		
PLUTO	5,900	247.7 years	6 days 9 hr	0.250	2,300	0.0025	2.0	1		
EARTH'S MOON	149.6 (0.386 from Earth)	27.3 days	27 days 8 hr	0.055	3,476	0.0123	3.3	—		

## Which are more dense? Jovian or terrestrial

Solar System Data										
Object	Mean Distance from Sun (millions of km)	Period of Revolution	Period of Rotation	Eccentricity of Orbit	Equatorial Diameter (km)	<b>Mass</b> (Earth = 1)	<b>Density</b> (g/cm <sup>3</sup> )	Number of Moons		
SUN			27 days		1,392,000	333,000.00	1.4			
MERCURY	57.9	88 days	59 days	0.206	4,880	0.553	5.4	0		
VENUS	108.2	224.7 days	243 days	0.007	12,104	0.815	5.2	0		
EARTH	149.6	365.26 days	23 hr 56 min 4 sec	0.017	12,756	1.00	5.5	1		
MARS	227.9	687 days	24 hr 37 min 23 sec	0.093	6,787	0.1074	3.9	2		
JUPITER	778.3	11.86 years	9 hr 50 min 30 sec	0.048	142,800	317.896	1.3	16		
SATURN	1,427	29.46 years	10 hr 14 min	0.056	120,000	95.185	0.7	18		
URANUS	2,869	84.0 years	17 hr 14 min	0.047	51,800	14.537	1.2	21		
NEPTUNE	4,496	164.8 years	16 hr	0.009	49,500	17.151	1.7	8		
PLUTO	5,900	247.7 years	6 days 9 hr	0.250	2,300	0.0025	2.0	1		
EARTH'S MOON	149.6 (0.386 from Earth)	27.3 days	27 days 8 hr	0.055	3,476	0.0123	3.3	—		

## Which have more moons ? Jovian or terrestrial

Object	Mean Distance from Sun (millions of km)	Period of Revolution	Period of Rotation	Eccentricity of Orbit	Equatorial Diameter (km)	<b>Mass</b> (Earth = 1)	<b>Density</b> (g/cm <sup>3</sup> )	Number of Moons
SUN	_	_	27 days	_	1,392,000	333,000.00	1.4	_
MERCURY	57.9	88 days	59 days	0.206	4,880	0.553	5.4	0
VENUS	108.2	224.7 days	243 days	0.007	12,104	0.815	5.2	0
EARTH	149.6	365.26 days	23 hr 56 min 4 sec	0.017	12,756	1.00	5.5	1
MARS	227.9	687 days	24 hr 37 min 23 sec	0.093	6,787	0.1074	3.9	2
JUPITER	778.3	11.86 years	9 hr 50 min 30 sec	0.048	142,800	317.896	1.3	16
SATURN	1,427	29.46 years	10 hr 14 min	0.056	120,000	95.185	0.7	18
URANUS	2,869	84.0 years	17 hr 14 min	0.047	51,800	14.537	1.2	21
NEPTUNE	4,496	164.8 years	16 hr	0.009	49,500	17.151	1.7	8
PLUTO	5,900	247.7 years	6 days 9 hr	0.250	2,300	0.0025	2.0	1
EARTH'S MOON	149.6 (0.386 from Earth)	27.3 days	27 days 8 hr	0.055	3,476	0.0123	3.3	—

# Which have longer periods of revolution?

Solar System Data									
Object	Mean Distance from Sun (millions of km)	Period of Revolution	Period of Rotation	Eccentricity of Orbit	Equatorial Diameter (km)	<b>Mass</b> (Earth = 1)	Density (g/cm <sup>3</sup> )	Number of Moons	
SUN			27 days		1,392,000	333,000.00	1.4	_	
MERCURY	57.9	88 days	59 days	0.206	4,880	0.553	5.4	0	
VENUS	108.2	224.7 days	243 days	0.007	12,104	0.815	5.2	0	
EARTH	149.6	365.26 days	23 hr 56 min 4 sec	0.017	12,756	1.00	5.5	1	
MARS	227.9	687 days	24 hr 37 min 23 sec	0.093	6,787	0.1074	3.9	2	
JUPITER	778.3	11.86 years	9 hr 50 min 30 sec	0.048	142,800	317.896	1.3	16	
SATURN	1,427	29.46 years	10 hr 14 min	0.056	120,000	95.185	0.7	18	
URANUS	2,869	84.0 years	17 hr 14 min	0.047	51,800	14.537	1.2	21	
NEPTUNE	4,496	164.8 years	16 hr	0.009	49,500	17.151	1.7	8	
PLUTO	5,900	247.7 years	6 days 9 hr	0.250	2,300	0.0025	2.0	1	
EARTH'S MOON	149.6 (0.386 from Earth)	27.3 days	27 days 8 hr	0.055	3,476	0.0123	3.3	—	

Complete the rest yourself

## Models of the Solar System

## **Geocentric** - Earth- Centered



#### Geocentric Model: Earth Centered

Explained the following:

#### - Earth was stationary with the sun

Moons and planets revolving around it

- Night and Day

- Revolution of the moon

Did not easily explain the following:

- Movement of the inner and outer planets



## **Heliocentric**

## - Sun- Centered



#### Heliocentric Model: Sun Centered

Explained the following:

- Puts sun in the center of our solar system
- Day and Night
- Seasons
- Motions of Celestial Objects



Heliocentric Model

Copernicus, Brahe, Kepler, Galileo and other scientists in the 16<sup>th</sup> and 17<sup>th</sup> centuries supported this model. This is the model we use today.

#### Shape of Orbit

The planets move in ellipses with the Sun at one focus

## Shape of Earth's orbit: Slightly elliptical with the sun at one foci

Eccentricity How "oval" an orbit is

#### Eccentricity = Distance between foci Length of major axis

Formula:

# Calculate the eccentricity of the ellipse below:

length of major axis



#### Formula: eccentricity = distance between foci length of major axis

Major axis Determine the eccentricity of the ellipse to the right: Distance between foci A circle has an eccentricity of \_ \_, and is least eccentric. 1) The more oval an ellipse is the **more** eccentric it is. 2)

## What keeps the planets in their orbit? <u>\*GRAVITY</u>

The Force of Gravity

1) Gravity An invisible force of attraction

2) Gravity depends on two things: Mass and Distance

3) The larger the mass, the <u>**Greater**</u> the gravitational attraction.

4) The closer objects are together, the **Greater** the attraction.

Fact(s) to memorize: 22 - 26

#### **Planet Velocities**

The line joining the Sun and a planet sweeps out equal areas in equal intervals of time

- Between which two letters is the orbital speed the slowest? \_\_\_\_\_
- 2. Between which two letters is the orbital speed the fastest?



3. The area's covered by the Earth as it travels from A to B  $\,$  and from C to D are

The speed of a planet depends upon its distance from the \_\_\_\_\_.

#### Distance of planets with respect to the Sun

Perihelion \_\_\_\_\_

Aphelion \_\_\_\_\_

The square of the time  $(T^2)$  of revolution of a planet divided by the cube of its mean distance (R<sup>3</sup>) from the Sun gives a number that is the same for all the planets

the diagram of the ellipse below.





2. State how the eccentricity of the given ellipse compares to the eccentricity of the orbit of Mars.

(packet pg 21)

Stars start out is a nebula which is a massive cloud of dust, hydrogen, and plasma.

Due to gravitational attraction the cloud collapses and temperature increases, nuclear fusion is taking place where hydrogen is becoming helium.

A protostar forms. From there, stars can become a main sequence star or a massive star.



# What are the main classifications of stars?

# Supergiants Giants Main Sequence White Dwarfs







Luminosity is the brightness of stars compared to the brightness of our Sun as seen from the same distance from the observer.





#### Arcturus



Sun (1 pixel)

Jupiter is invisible at this scale

Sinus Pollux Arcturus

Rigel Ald

Aldebaran

## Antares

What two characteristics are used to classify stars?

#### Luminosity

and

#### **Temperature**



Luminosity is the brightness of stars compared to the brightness of our Sun as seen from the same distance from the observer.



on the chart above.

Shade the chart where all of the stars are hotter than our sun.

Draw a line on the chart which separates those stars brighter than our sun and those less bright.

The star Betelgeuse is located in the constellation Orion. What color is it? **Red**The star Rigel is located in the constellation Orion. What color is it? **White** 

#### How do stars generate their energy? Nuclear Fusion



2005/01/19 19:19

## Earth in the Universe



#### Galaxy

### Galaxy - collection of billions of stars, planets and various amounts of gas and dust held together by gravity.



What is the name of our galaxy? Milky Way



What kind of a galaxy do we live in? **Spiral Galaxy** 

Where is our solar system located within the galaxy In one of the Spiral arms



The Universe

## The Universe Includes everything that exists from the smallest object to the largest galaxies.



## Big Bang Theory

#### About 14 billion yrs ago a massive explosion took place and started the formation of the universe.

http://resources.schoolscience.co.uk/PPAR C/bang/bang.htm


# evidence - The universe is expanding in every direction.

- Doppler Effect  $\rightarrow$  Red Shift
- Cosmic background radiation



The diagram below illustrates three stages of a current theory of the formation of the universe.







A ball of hydrogen exploded.

A huge hydrogen cloud moved outward with cloud parts condensing to form galaxies.



Stage 3 (present)

The galaxies continue to move outward.

#### Spectral lines

## - The separation of different colors based on wavelength



## - Why we have rainbows



#### red shift:

## - Objects moving away cause by explosion of space

Violet		Red
Spe	ectral lines	
	Red Shift	5525
(pat	ttern moves to right)	
Violet		Red
Spe	ectral lines	
	Violet Shift	

blue shift:

- Objects moving towards another object

# Shifts in the Electromagnetic Spectrum



http://www.ww norton.com/co llege/geo/ege o/flash/1\_2.sw f

# Red Shift = awayBlue Shift = toward

http://www.color ado.edu/physic s/2000/applets/ doppler2.html



#### The Doppler Effect for a Moving Sound Source