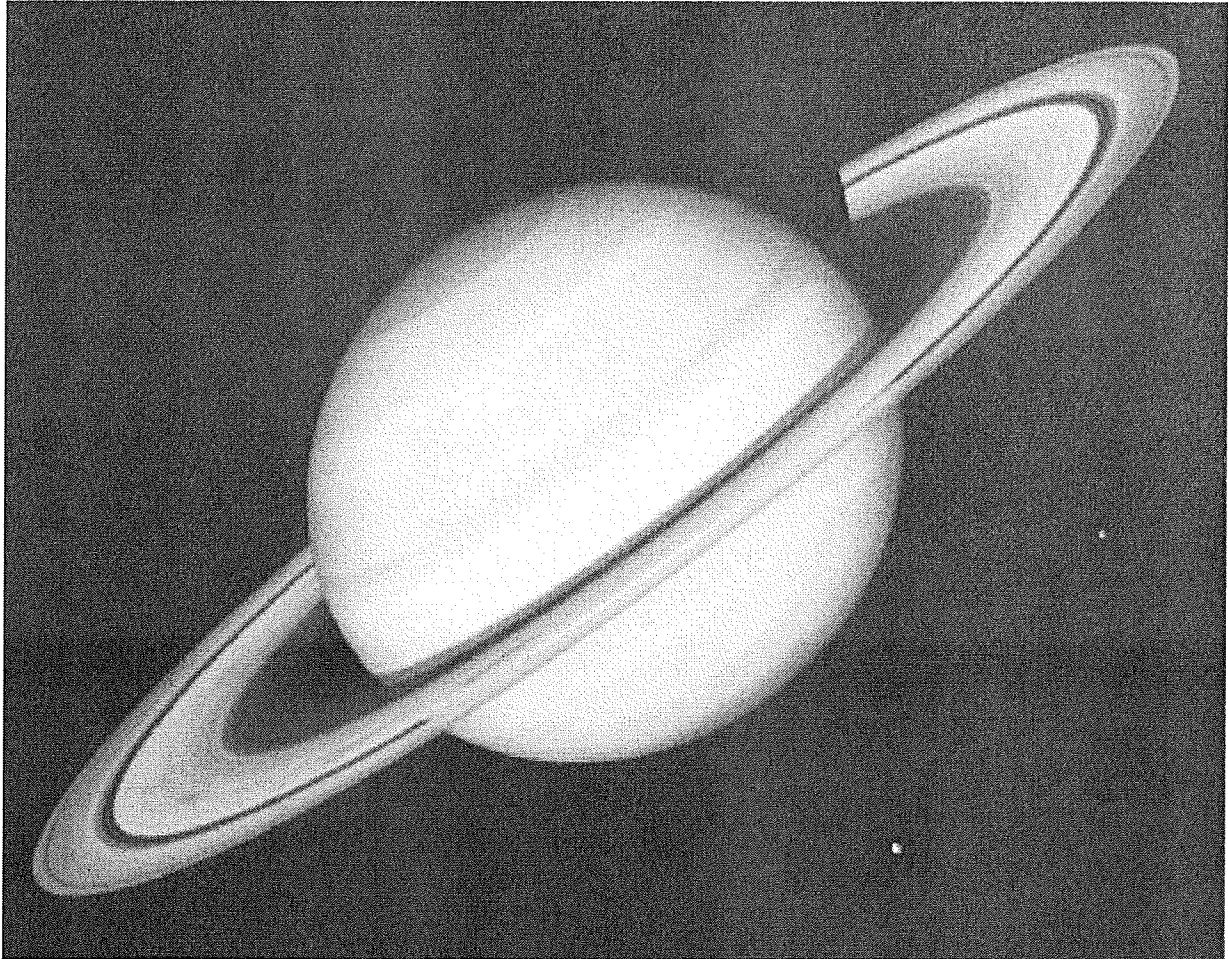# Earth Science 11

Astronomy Unit

Astronomy Vocabulary

```
E  S  D  K  E  O  R  X  S  B  D  L  F  T  B  T  R  T  E  S  P  Z  R  T  V
M  S  H  O  F  P  A  E  L  A  G  O  R  A  I  G  S  E  S  T  R  J  E  N  K
R  B  R  B  P  L  O  A  V  Q  T  I  I  D  S  Z  W  N  W  S  W  I  D  A  X
A  E  P  E  L  P  C  C  S  O  A  E  E  R  S  Z  U  A  A  D  H  W  S  I  J
H  X  D  A  V  K  L  X  S  N  L  S  L  Q  E  S  M  L  L  Q  I  A  H  G  I
N  H  R  G  H  I  Y  E  G  O  I  U  Q  L  E  T  U  P  S  B  T  L  I  S  H
K  A  X  O  I  D  N  U  R  Q  R  E  T  S  I  R  S  L  R  N  E  R  F  A  X
P  I  L  N  H  A  L  U  E  E  Q  T  A  I  L  T  G  A  E  E  D  A  T  G  G
O  E  L  J  Z  A  N  K  G  B  F  H  C  E  O  V  E  I  L  B  W  E  P  S  V
E  P  N  J  T  C  G  T  K  N  P  F  B  E  Y  N  T  R  P  U  A  Y  I  X  Z
M  C  K  I  X  G  N  A  B  G  I  B  E  J  P  I  Y  T  E  L  R  T  Q  N  P
N  W  O  T  N  E  R  A  P  P  A  T  A  C  N  S  X  S  K  A  F  H  Z  D  D
J  N  M  E  T  E  O  R  I  O  D  Y  A  U  T  P  A  E  Z  R  K  G  E  X  T
E  C  N  E  U  Q  E  S  N  I  A  M  L  L  F  L  L  R  H  T  H  I  B  E  E
P  L  A  N  E  T  H  R  W  V  E  A  L  B  L  Z  A  R  M  H  T  L  K  G  L
W  H  E  J  U  B  O  M  T  T  C  Q  R  K  Q  I  G  E  V  E  F  U  T  D  E
M  N  M  C  B  T  G  A  S  I  C  H  U  P  E  T  C  T  A  O  F  N  Z  D  S
Z  A  O  M  A  H  B  Y  M  N  O  O  M  A  Q  G  X  S  W  R  Y  S  U  N  C
B  E  R  T  O  S  S  O  L  U  M  I  N  O  S  I  T  Y  O  Y  T  T  R  W  O
F  J  I  G  O  R  N  C  O  N  S  T  E  L  L  A  T  I  O  N  I  C  N  P  P
O  O  A  L  A  O  T  N  A  I  G  E  U  L  B  Q  R  I  N  N  Y  O  E  U  E
N  K  U  L  R  I  R  E  D  D  W  A  R  F  R  S  F  E  G  M  C  M  S  P  Z
L  T  O  T  D  H  D  O  B  L  B  J  M  Y  I  L  D  A  U  T  K  E  P  K  S
E  S  S  D  V  Y  Y  R  D  N  D  V  H  N  R  V  M  P  Z  Q  C  T  R  M  W
K  A  B  P  H  D  W  L  H  X  V  L  B  L  N  S  H  S  C  F  O  A  W  X  P
```

ABSOLUTE
ASTRONOMICALUNIT
BLUEGIANT
DOPPLEREFFECT
HRDIAGRAM
LUMINOSITY
METEORIOD
OSCILLATINGUNIVERSE
PLANET
REDGIANT
ROTATION
SPECTRA
TERRESTRIALPLANET
WHITEDWARF

APPARENT
BIGBANG
COMET
GALAXY
KEPLERSLAWS
MAGNITUDE
MOON
PARALLAX
QUASAR
REDSHIFT
SATELLITE
SPECTROSCOPE
TIDES

ASTERIOD
BLACKHOLE
CONSTELLATION
GASGIANT
LIGHTYEAR
MAINSEQUENCE
NEBULARTHEORY
PHASES
REDDWARF
REVOLUTION
SOLARSYSTEM
TELESCOPE
TRIANGULATION

Bloom's Question Starters

Level 1 & 2: Knowledge & Understanding
- Arrange, define, duplicate, label, list, memorize, name, order, recognize, relate, recall, repeat, who, when, where
- Classify, describe, discuss, explain, express, identify, indicate, locate, recognize, report, restate, review, select, translate, complete
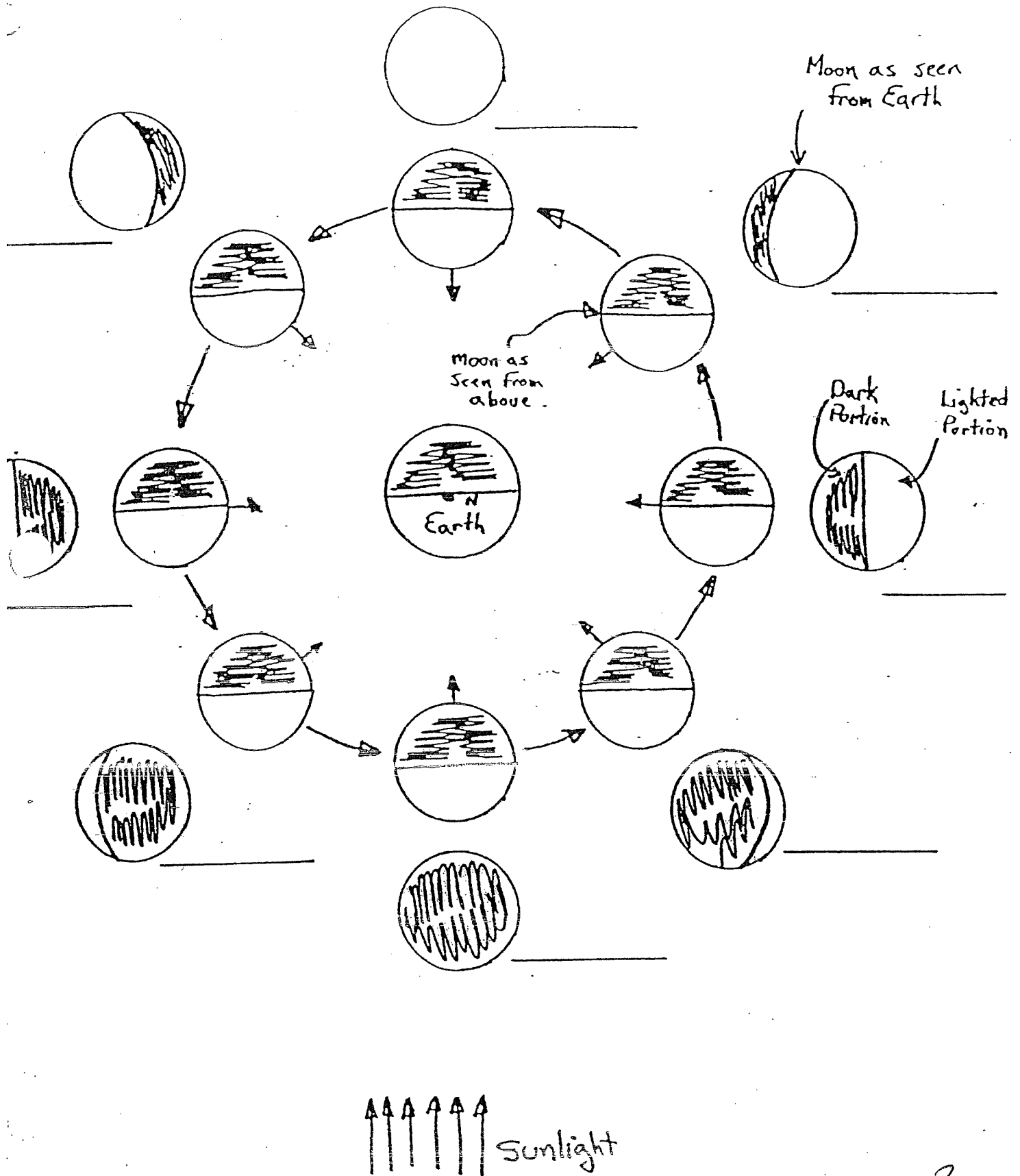
Level 3 & 4: Application & Analysis
- Apply, choose, demonstrate, dramatize, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use, write
- Analyze, calculate, categorize, compare, contrast, criticize, differentiate, distinguish, examine, experiment, question, test, find hidden meaning

Level 5 & 6: Synthesis & Evaluation
- Arrange, assemble, collect, compose, combine, rearrange, construct, create, design, develop, formulate, manage, organize, plan, prepare, propose, set up, generalize, rewrite
- Appraise, argue, assess value, attach, discriminate, defend estimate, judge, predict, rate, recommend, select, support, value, evaluate, conclude, reason

2

Phases of the Moon

Moon as seen from Earth

Moon as Seen From above.

Earth

N

Dark Portion

Lighted Portion

↑↑↑↑↑↑ Sunlight

3

Phases of the Moon

- only _____ the moon is lit at one time by the sun
- phases depend on _____ of that lit side of the moon we can actually_____
- depends on the _____ of the Earth, moon and sun
- moon takes 27 and 1/3 days to _____ Earth, Earth spins on axis once every __ hours
- phases are _____ the Earth casting its shadow on the moon!

- i.e. a _____ moon is only "visible" during the _____ (we are "seeing" the _____ side only)
- a _____ moon is only visible at _____ (rises as the sun sets, sets as the sun rises), we are seeing the entire _____ side
- note: the moon's orbital plane is inclined __ degrees to our orbital plane around the sun, that is why we don't see eclipses normally, just phases
- note of interest: moon's rotation takes as long as revolution so the _____ always faces Earth! (always see the "man in the moon")

Eclipses

Lunar Eclipse
- when the shadow of the Earth covers the moon
- can only happen near the full moon phase
- happens twice a year
- entire night side of Earth sees it, so we see them more often that a solar eclipse

Solar Eclipse
- when the moon blocks the sun from our view
- can only happen near the new moon phase
- happens 2 to 5 times a year
- small shadow, one spot on Earth will only see a full solar eclipse once every 300 years

What happens to stars in the sky as a result of our

rotation (on axis)? – _____ from view temporarily, night turns to day, too light

revolution (around the sun)? – see different stars (different ones on each _____ of sun), the dippers, etc. are always there because they are more _____ the solar system rather than beside

4

Seasons
- due to the_____, sun hits more directly
- we are actually _____ to the sun during the Northern Hemisphere's_____

Length of Day Changes
- _____ when the sun is hitting more_____, the day side stays out of the shadow_____

Tides
- the _____ 's gravity (and sun's) cause the tides on Earth
- high tide occurs when the moon is directly _____ the location of high tide
- _____ of moon (and sun) pulls on the _____ closest to the moon most, then some on the Earth and less on the water on the other side (leaving a _____of water left behind)

- highest high tide occurs when the moon and sun are_____
- lowest high tide occurs when the moon and sun are_____

Foucault's Pendulum
- is evidence for the _____ of the Earth (rather than everything orbiting around us)
- a heavy mass on a string has "_____" (the resistance to change in motion). So, once a pendulum starts swinging it _____ to keep going in the same direction. If we let it go for several hours it appears that the pendulum is swinging in a _____ direction though! How? The pendulum hasn't changed direction! Therefore the _____ must have _____ underneath it. In 24 hours the pendulum will be swinging back in the _____ direction (the Earth will have completed one rotation on its axis.)

- other evidence for the fact that the Earth rotates is that all the stars, sun, moon, etc., rise in the _____ and set in the _____ at the same _____ as each other every day.

How to Determine Earth's
volume - from dimensions and formula _____ for a sphere

density = _____, calculate the mass from the interaction we see of the _____ between Earth and other bodies (sun, moon, masses on Earth, even you!)

shape = _____, not flat – evidence: 1)sail of a ship appears _____ the ship itself, 2)_____ shadow on moon during lunar eclipse (no matter which edge of Earth is casting the shadow).

escphase.doc

5

Solar System Lab

You are an alien from another system. The Solar System has recently been discovered and your mission is to find out, and report to your captain (me), about it.

The GRB Lottery

On your way to the Solar System, you detected a lot of gamma rays bursts (GRB) coming your way that kept fading away before you could get a good look at them. After some research you've learned that they happen when a star goes supernova and forms a black hole. Your interest was tweaked by the randomness of the bursts' locations and you "happened" to run across a Lottery program on Earth's computer system designed for you to make guesses as to where the next burst will occur. (The closest guesser wins a certificate and NASA educational materials!)   *Omit*

1. Go to http://swift.sonoma.edu/grb_lotto
2. Read up on Gamma-Ray Bursts to find out how often they could be seen from here on Earth.
3. Make a guess and then forward the confirmation email to me at tdella@sd43.bc.ca with a **subject line** that says "Guess of ... , *your name and block.*" Also, please include your reasoning for choosing that location in the body of the email.

The Solar System Mission

The Planets

Mercury
1. Is there an atmosphere?
2. What caused all the craters on this rocky planet?
3. Lots of craters means that a surface is old, why?
4. What causes the two extremes in temperature (very hot and very cold)? – Two reasons.

Venus   WARNING: Temperatures are too hot. You will be destroyed if you land.
1. What direction does Venus rotate (on its axis)?
2. What is the composition of the atmosphere?
3. What is the surface temperature and why is it so high?
4. Why does this rocky planet not have many craters?
5. Why do Mercury and Venus have no moons?

Earth
1. Give a brief description of the surface features.
2. Which planet does Earth's Moon most resemble?

Mars
1. The atmosphere is very thin yet there are huge dust storms, why?
2. Why does the planet appear red (has to do with the dust)?
3. What are the ice caps made of?
4. How large is Olympus Mons? What is it?
5. How many moons orbit Mars? Where are they believed to have come from?

Jupiter
1. What is that huge red spot?
2. Apparently one of the moons is larger than Mercury – please confirm which one.
3. What is the current count of the number of moons orbiting this planet?

Saturn
1. How do the beautiful rings, made of rock and ice, form?
2. Which three planets, other than Saturn, have rings?
3. What is the current count of the number of moons orbiting this planet?

Uranus
1. Uranus' axis is tilted at an odd angle making it rotate backwards. Please draw it.
2. What is the current count of the number of moons orbiting this planet?

Neptune
1. What is the Dark Spot believed to be?
2. What is the current count of the number of moons orbiting this planet?

Other Objects

Asteroid Belt
1. Briefly describe what these objects look like.
2. How many of them are there?
3. Where are they located in the Solar System
4. How big is the biggest? What is its name?

Kuiper Belt
1. Where is this belt of objects located?
2. How many of them are there?
3. How big is the biggest? What is its name?

Dwarf Planets
1. Pluto is now classified as a Dwarf Planet. List the other Dwarf Planets in the Solar System.
2. Sketch why Neptune is sometimes further from the Sun than Pluto.
3. Produce a reasonable argument as to whether you believe Pluto should be classified as a regular Planet or a Dwarf Planet in the Kuiper Belt. Use web references to back up your ideas.

Comets
1. Describe the parts of a comet.
2. Why does the tail always point away from the sun?

Solar System
Wordsearch with Clues

1. the minimum velocity needed to escape gravity's pull [14]
2. surface similar to earth's moon [7]
3. surface of Venus hot because of _____? [16]
4. on Mars strong winds cause _____? [10]
5. our sister planet [5]
6. has polar ice caps [4]
7. oval area of swirling atmosphere on Jupiter [7]
8. planet that was hit by a comet summer 1994 [7]
9. Saturn is famous for ____? [5]
10. farthest planet out ▬ [7]
11. smallest planet [5] *(Now a dwarf planet)*
12. bodies that revolve around planets [10]
13. most geologically active body in solar system [2]
14. largest moon in solar system (larger than Mercury!) [8]
15. Mercury and Venus have no _____? [5]
16. Pluto's moon [6] *(biggest one)*
17. part of a comet (inside head) [7]
18. Ceres and Pallas are the two largest [9]
19. light made by a rock fragment burning in atmosphere [6]
20. meteoroid that reaches earth [9]
21. when Venus is west of the sun it is a _____ star [7]

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E M E T E O R I T E E T N Q V U R M S
S S R N P J A N N O S G N I N R O M H
T P C T U V S A T E L L I T E S N J F
R F P A Q S U E L C U N N R O S U Q I
C H O O P P M A R S M E T E O R F T I
A X G R E E N H O U S E E F F E C T N
B Z A S U N V S G N I R N I O T S O R
X G N Y T I C E O E O T U L P I V P Q
C I Y D E L L A L V S T T L B P N S I
D Q M O O N S V Y O Q R P N A U U D E
Z M E S C T A Y R U C R E M S J E E U
F S D O T C H A R O N I N V L I A R T
G I E R O E T C K D U S T S T O R M S
Y T N O S D I O R E T S A Y P H A U M
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PURPOSE: To measure the diameter of the Sun.

PROCEDURES:

1. Assemble the apparatus as shown. Punch the hole in the foil with a pin (you may have to enlarge the hole with a pencil point on dull days).

2. Align the apparatus with the Sun. Mark the diameter of at least three images on the small sheet of paper. Calculate the average diameter of these images. DO NOT LOOK through the hole at the Sun.

3. Use the average image diameter to calculate the diameter of the Sun using the ratio below.
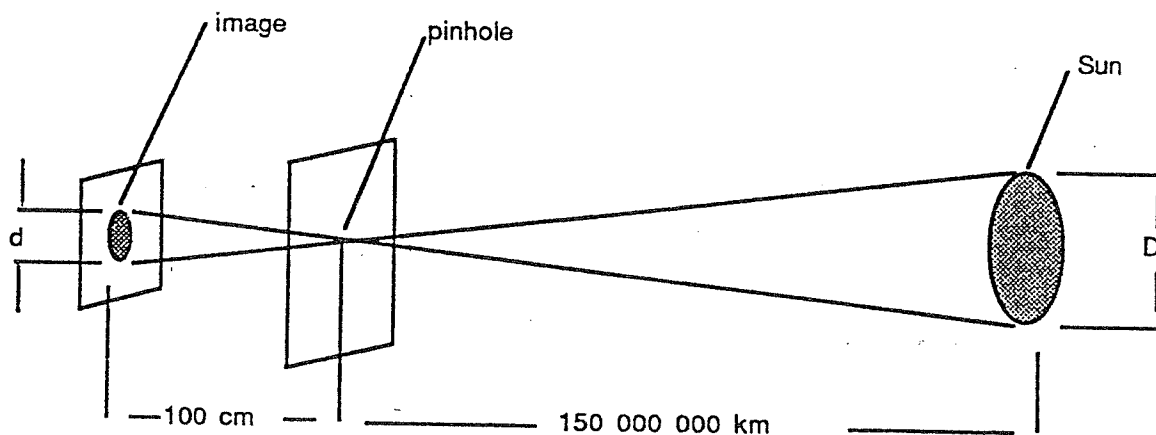
RATIO: $\dfrac{d}{100 \text{ cm}} = \dfrac{D}{150\,000\,000 \text{ km}}$ (d in centimetres)

4. Calculate your percentage error.

5. Use the "long box" apparatus to measure the diameter of the image produced by it's pinhole. Calculate the diameter of the Sun from this Information. Is this method more or less accurate.

QUESTIONS:

1. What are the sources of error in this method?

2. How could the apparatus be improved? Sketch your suggestions.

3. Could you make a permanent image of the Sun using this type of apparatus? Explain.

Sun Diagram

Using class notes, and the internet, **draw** a detailed picture or pictures of the sun.
(draw in space below).

Important:
Include a definition list with you picture that defines and describes ALL the features and
layers included on your diagram(s). (definitions on next page ——>)
I.E. photosphere – the bright yellow surface layer of the sun ~400km thick.

Include all features from our notes (the layers of the sun, sunspots, solar flares, etc.) You
should have at least 7 labeled features in total.

Try to make your diagram somewhat to scale. I.E. 400km is much less than 1,380,000km
so draw it much thinner too.

Colour your diagram too, if possible.

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	Brightest stars	Visual magnitude	Distance (light-years)	Temperature (degrees Kelvin)	Luminosity (Sun = 1)
	Sirius A	− 1.43	8.7	10,400	23.0
	Canopus°	− 0.72	100.0	7,400	1,500.0
	Alpha Centauri A	− 0.01	4.3	5,800	1.5
	Arcturus°	− 0.06	36.0	4,500	110.0
	Vega°	+ 0.04	26.0	10,700	55.0
	Capella	+ 0.05	47.0	5,900	170.0
	Rigel	+ 0.14	800.0	11,800	40,000.0
	Procyon A	+ 0.38	11.3	6,500	7.3
	Betelgeuse°	+ 0.41	500.0	3,200	17,000.0
	Achernar°	+ 0.51	65.0	14,000	200.0
	Beta Centauri°	+ 0.63	300.0	21,000	5,000.0
	Altair°	+ 0.77	16.5	8,000	11.0
	Alpha Crucis	+ 1.39	400.0	31,000	4,000.0
	Aldebaran°	+ 0.86	53.0	4,200	100.0
	Spica°	+ 0.91	260.0	21,000	2,800.0
	Antares°	+ 0.92	400.0	3,400	5,000.0
	Fomalhaut	+ 1.19	23.0	9,500	14.0
	Deneb°	+ 1.26	1,400.0	9,900	60,000.0
	Beta Crucis	+ 1.28	500.0	22,000	6,000.0
Nearest stars	Sun	− 26.7	0.00002	5,800	1.00
	Alpha Centauri A°	− 0.01	4.3	5,800	1.5
	Alpha Centauri B°	+ 1.4	4.3	4,200	0.33
	Alpha Centauri C°	+ 11.0	4.3	2,800	0.0001
	Barnard's Star	+ 9.54	6.0	2,800	0.00045
	Wolf 359°	+ 13.66	7.7	2,700	0.00003
	Lalande 21185°	+ 7.47	8.1	3,200	0.0055
	Sirius A°	− 1.43	8.7	10,400	23.0
	Sirius B	+ 8.5	8.7	10,700	0.0024
	Luyten 726-8 A°	+ 12.5	8.7	2,700	0.00006
	Luyten 726-8 B°	+ 12.9	8.7	2,700	0.00002
	Ross 154°	+ 10.6	9.6	2,800	0.0004
	Ross 248°	+ 12.24	10.3	2,700	0.00011
	Epsilon Eridani°	+ 3.73	10.8	4,500	0.30
	Ross 128°	+ 11.13	11.0	2,800	0.00054
	Luyten 789-6	+ 12.58	11.0	2,700	0.00009
	61 Cygni A°	+ 5.19	11.1	4,200	0.084
	61 Cygni B°	+ 6.02	11.1	3,900	0.039
	Procyon A°	+ 0.38	11.3	6,500	7.3
	Procyon B°	+ 10.7	11.3	7,400	0.00055
	Epsilon Indi°	+ 4.73	11.4	4,200	0.14
Other stars	Epsilon Andromedae	+ 4.37	105	5,600	1.3
	Delta Aquarii°	+ 3.28	84	9,400	24.0
	Beta Aquarii	+ 2.86	1030	6,000	4,300.0
	Beta Auriagae	+ 2.8	88	11,200	69.0
	Beta Cassiopeiae	+ 2.26	45	6,700	8.2
	Grw + 70° 8247	+ 13.19	49	9,800	0.0013
	02 Eridani B°	+ 9.5	16	11,000	0.0028
	L 879-14°	+ 14.10	63?	6,300	0.00068
	70 Ophiuchi A°	+ 4.3	17	5,100	0.6
	Zeta Ophiuchi	+ 2.56	465	26,000	3,300.0
	Delta Persei°	+ 3.03	590	17,000	1,300.0
	Zeta Persei A°	+ 2.83	465	24,000	16,000.0
	Tau Scorpii°	+ 2.82	233	25,000	2,500.0
	Van Maanen's Star°	+ 12.36	14	7,500	0.00016
	W 219	+ 15.20	46	7,400	0.00021

**PURPOSE:**   To study a method by which the types of stars can be determined.

In 1912, two astronomers, Hertzsprung (in Holland) and Russell (in USA), independently studied the relationships between the temperature and luminosity for a large group of stars. These properties were plotted on a graph which led to the discovery that stars exist as only a few types and not as a range of all possible combinations of temperature and luminosities. This graph became known as the H - R Diagram and a great deal of modern astronomy is based on it.

PROCEDURES:

On the grid provided plot the temperature and luminosity of the stars listed and marked with a " * " . Do not join the points with a line.

QUESTIONS:

1.   Examine the axis of the graph. How are they numbered? Is this the normal method of numbering? Why is this method used here?

2.   Where is the sun located on the graph?

3.   Describe the shapes produced by the groupings of points.

4.   Where do most of the points fit on the graph?

5.   Where is the smallest group of stars located on the graph?

6.   What is the significance of the H-R diagram to modern Astronomy?

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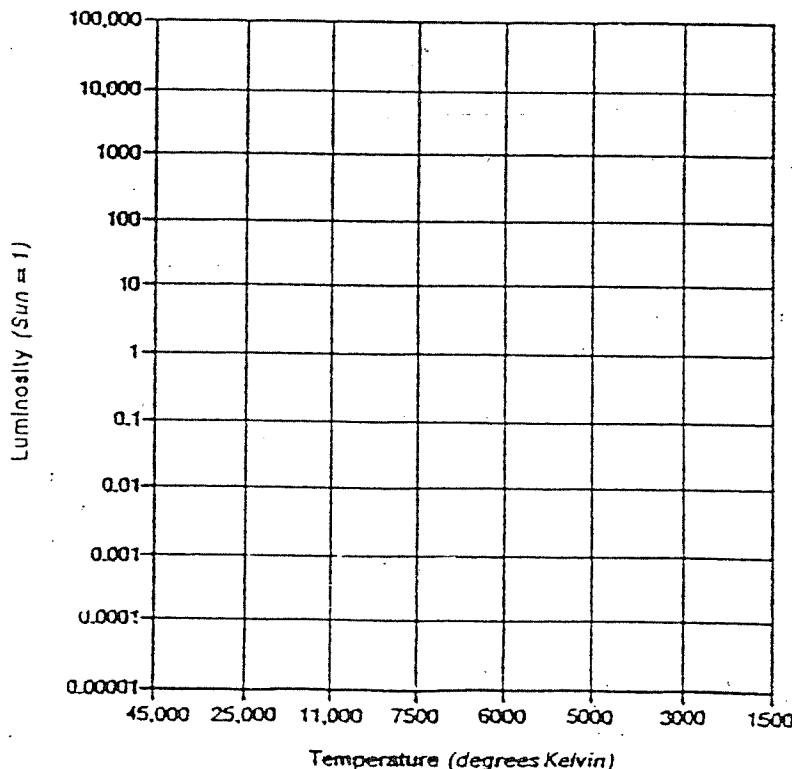
STAR TYPES

1. What do the initials H and R stand for in the H-R diagram?

2. What properties of the stars are plotted on the axis of the H-R diagram?

3. Where do most of the stars fit in the diagram?

4. Why must the stars in the upper right of the diagram be very large stars?

5. Why must the stars in the lower left of the diagram be very small stars?

6. What color must the stars on the right edge of the diagram be? Why?

7. What color must the stars on the left edge of the diagram be? Why?

8. Name a red supergiant star. Name a red giant star. Name a blue-white giant star.

9. How are the temperature and luminosity linked for stars in the main sequence?

10. The temperature of stars is measured in degrees Kelvin. What is the Kelvin scale? (you will need to look in a reference source for this.)

PURPOSE: To study one method of measuring distances to distant objects.

PROCEDURES:

1. a) From position A in the classroom, sight at the ball, using one eye only. Make a sketch of it's apparent position compared to the wall behind it.

    b) Move to position B. Repeat the procedures above. What changes occur as you move from one side to the other?

2. Move 2 metres closer to the ball and repeat 1a and 1b. Make sketches each time. What changes have occurred from procedure 1?

3. Move 2 metres back from the original position and repeat 1a and 1b. What is the difference this time?

4. The ball will be moved closer to the wall. Stand as far back from the ball as you can and repeat 1a and 1b.

    Summarize your observations in one or two sentences as to what appears to happen to the ball as you, the observer, are closer or farther from the ball.

QUESTIONS:

1. In which position of observation of the ball, 1, 2, 3, or 4, was the apparent shift the greatest? In which position was it the least?

2. Define: parallax.

3. Would parallax be most useful to measure distances to near object or far objects? Explain your answer.

4. Draw a sketch, as though you were looking down on the room, to show why the apparent shift is noticed in procedure 1.

5. How could the distances to stars be measured using parallax? Hint: Think about how the Earth moves around the sun.

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Parallax Lab

Purpose: To study a method of measuring distances in space.

Procedure/Data:

Position	Put circle where ball appears in # sequence									
starting positions 1A	1	2	3	4	5	6	7	8	9	10
1B	1	2	3	4	5	6	7	8	9	10
2m closer 2A	1	2	3	4	5	6	7	8	9	10
2B	1	2	3	4	5	6	7	8	9	10
2m other further 3A	1	2	3	4	5	6	7	8	9	10
3B	1	2	3	4	5	6	7	8	9	10

Summary: (Answer this: What appears to happen to the ball compared to the background as you moved closer and further from the globe?) ie where is greatest and least shift seen?

Questions: #1-5

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Gamma Ray Burst Bead Activity

GRB's result from the most energetic explosions that occur in space since the Big Bang 13.7 billion years ago. They signal the formation of supermassive black holes. We can learn about them by taking spectra (splitting light into a rainbow of colours.)

In this activity, the beads represent the number of photons collected for each colour in the spectrum of the GRB.
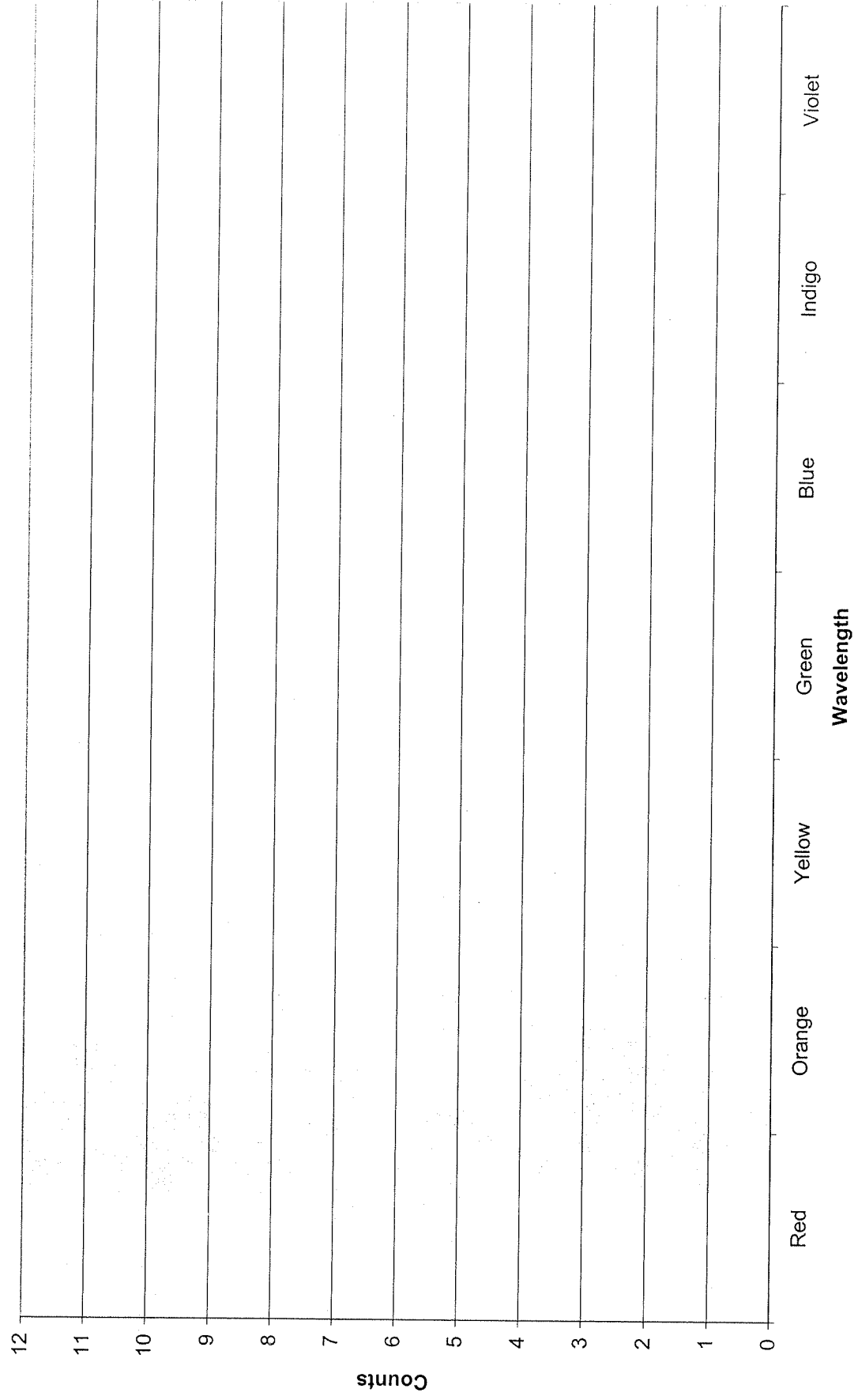
Your tasks:
1. Please do not open the bags. Count through the bag.
2. In one colour of pencil, plot a bar graph based on the number of coloured beads for each colour you find in the GRB bag.
3. At the bottom of the page make note of the colour of pencil you used for the GRB spectrum.
4. In a different colour of pencil, plot a second bar graph based on the number of coloured beads in the Lab Spectrum bag.
5. At the bottom of the page make note of the colour of pencil you used for the Lab Spectrum.

Questions:
1. List the parts of a spectroscope.
2. Why are there rainbow colours in a spectrum?
3. Give some examples of types of spectra and describe what they look like.
4. a. What is the relationship between the two spectra plots?
   b. What does this mean about the GRB?
5. If the GRB spectrum had been shifted toward the blue end of the bar graph compared to the lab spectra, what would this mean?
6. If the situation in question 5 were true, what do you think this would mean about the universe and it's ultimate fate?

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GRB 970228 Spectra

Counts (y-axis): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

Wavelength (x-axis): Red, Orange, Yellow, Green, Blue, Indigo, Violet

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DVD: "If We Had No Moon" (51 minutes)

1. What size of object hit the Earth creating the Moon?

2. If there were no sun, there would be no life on Earth, in fact there would be no Earth. If there were no moon, there would still be an Earth but no _____ .

3. The Moon is _____ the size of Earth.

4. Why is it not likely that the Earth and Moon formed at the same time?

5. Why is it not likely that the Earth captured the Moon?

6. Why is it not likely that the Moon is just an equatorial bulge that broke off?

7. _____ Apollo Missions ferried _____ astronauts to the Moon.

8. Moon rocks are most like what layer of the Earth?

9. Orphius is said to have been a planet between _____ and _____ that hit Earth and formed the Moon.

10. Why does Venus rotate backwards?

11. Why does Uranus rotate on its side?

12. How long does a collision take?

13. If there were a head on collision, _____ would form.

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14. The impact that formed our Moon almost missed. It was off center then there was a second hit within _____ days. The Moon coalesced in _____ years.

15. Moon was much closer so that there was _____ times the gravitational pull that is produces now → many more volcanoes, tsunamis then.

16. As the spin slows, the Moon _____.

17. Reflector on the Moon gives evidence that the Moon is retreating _____ a year.

18. The Moon stabilizes our _____ and _____.

19. What is a possible solution to losing the Moon?

20. Phases: half the moon is lit, we see different _____ depending where the Moon is in its orbit around the Earth.

21. If Earth had never had a moon we would have _____ days and be covered in _____.

22. Whose ashes are on the Moon? _____

23. How would they maybe make houses on the moon?

24. Gravity on the Moon is _____ that on Earth.

25. How likely is it that an Earth-like planet would form AND have such a large stabilizing, life-promoting moon?!

26. What is the last word that Captain Picard (the narrator) says? _____

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STARS, GALAXIES AND THE UNIVERSE

Use the following words to answer the questions below:

Refracting telescope	reflecting telescope	radio telescopes	nuclear fusion
~~Nuclear fission~~	Continuous spectrum	bright-line spectrum	galaxy
Spectroscope	Doppler effect	Astronomical unit	light-year
Hertzsprung-Russell	parallax	astronomy	quasar
circumpolar constellations	luminosity	Big Bang Theory	pulsar
Apparent magnitude	absolute magnitude	Nebula	new star/protostar
stable star	Red Giant	White Dwarf	Supernova
Neutron Star	Black Hole		

1. Star that has such high gravitational forces that not even light can escape from it
2. When heavier element split to form lighter elements = nuclear fission
3. Shows the relationship between temperature and luminosity of stars
4. The brightness of a star as it appears to us
5. star-like objects that emit light & radio waves → most luminous objects in universe
6. when objects move away from Earth, lines of spectrum shift to red end of spectrum
7. constellations that move around the north star (Polaris)
8. due to nuclear fusion, this type of star is formed which begins to shine and emit energy
9. type of optical telescope that uses mirror to collect and reflect light back on to object
10. when clouds of dust and gas join together to form this type of star
11. actual amount of energy given off by star at a standard distance
12. the name of the star type of the dense core left over after a supernova
13. spectrum that has series of lines of different colour with spaces in between colours
14. Type of optical telescope that uses lenses to collect and bend light
15. When a star breaks apart in a large explosion, it is called this
16. when lighter elements join to make heavier elements
17. ·⸱·ʇ ɘn a low-mass star cools and fades out, it is called this
18. true brightness of star (amount of power burning)
19. theory that the universe started off in one place & an explosion caused matter to spread out
20. when inward pressure of gravity & outward pressure of nuclear energy balance out this type of star is formed
21. unit of distance equal to the distance from Earth to sun (150,000,000 km)
22. continuous band of colours with no spaces between colours (e.g. light bulb)
23. device that separates light energy into its components (colours)
24. when fuel starts to run out, this medium mass star expands and becomes this
25. groups of billions of stars that are close together and bound by gravity
26. apparent shift in object against a background caused by a shift of the observer
27. telescopes that use dishes and antennas to collect radio waves
28. star that emits/gives off light and radio waves
29. study of composition, position & movement of all objects in universe
30. distance a ray of light travels in one year (9,460,000,000,000 km)

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