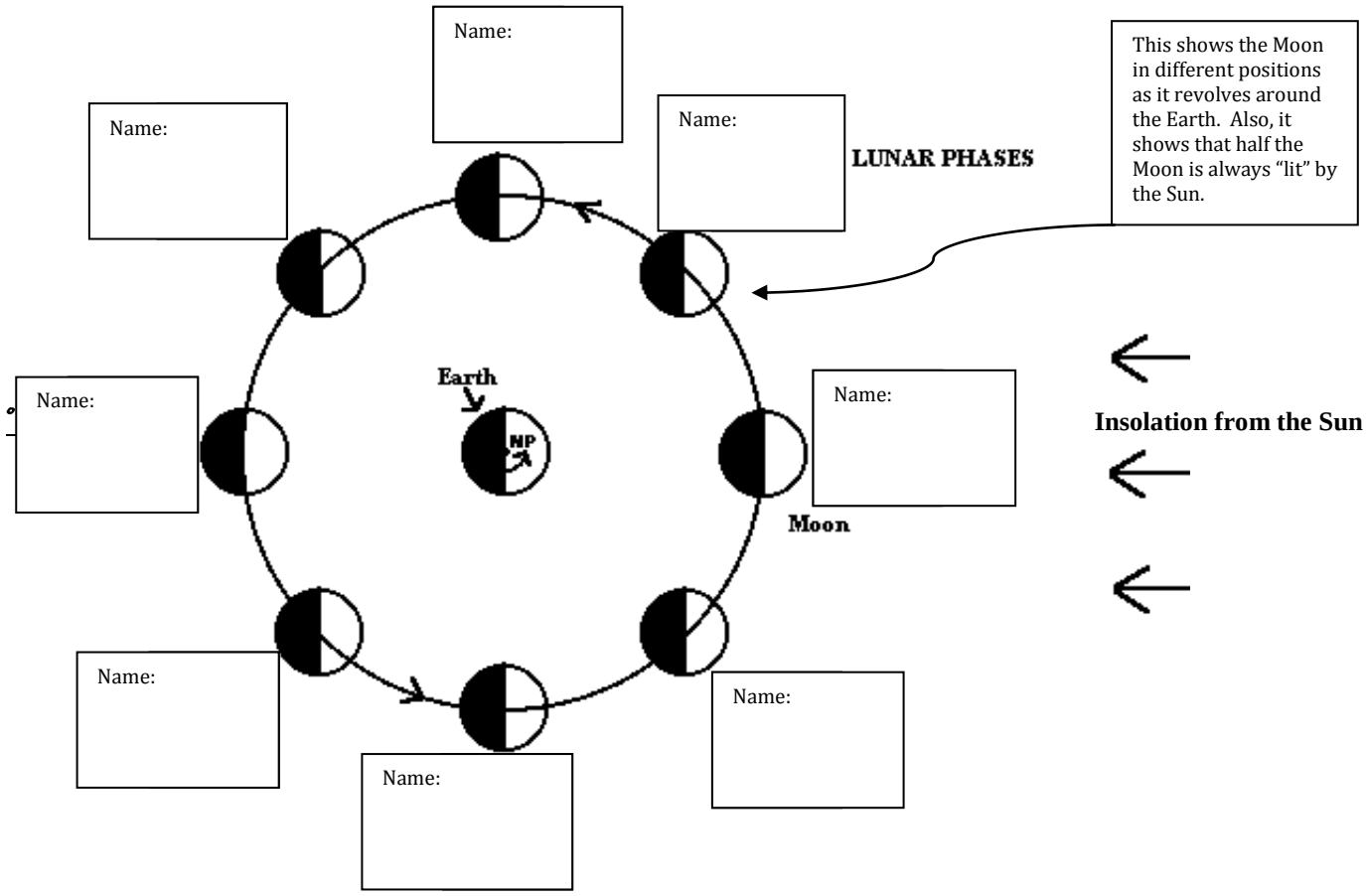
Name _____ Earth Science

Notes: Topic 10 – Beyond Earth

10.1 Moon's Phases – The Moon appears to move east to west across our sky because Earth is _____. At the same time, the moon revolves around earth, which causes it to have _____.

- Although the Moon rotates, the **same side of the moon always faces the earth** because its period of revolution equals its _____.
- **Phases of the Moon** are caused by the Moon _____around the Earth and observers from Earth seeing only a portion of the lit half of the moon.

You are responsible for knowing all phases. In each square, draw each phase as it would be seen from Earth when the Moon is located in that position. Label it with the phase name.



1. Regardless of phase, how much of the Moon is always lit by the Sun?

2. Why is the Moon sometimes visible during the day?

3. What causes the phases of the Moon?

4. According to your ESRT page 15, how long does it take the Moon to revolve around the Earth?

When on the link for phases of the Moon, follow these directions and answer these questions.

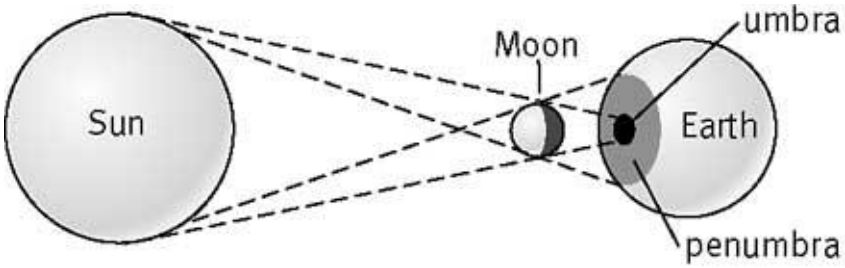
5. Move the Moon to the First Quarter phase, click on the Earth in the "main panel" and rotate it counter-clockwise. On the "horizon diagram", notice this makes the Sun and Moon rise in the east and set in the west. What time does the Moon rise on this day? _____
6.
7. Move the Moon to the Full Moon phase. What time does the Sun rise? _____ Sun set? _____ What time does the Moon rise? _____ Moon set? _____

8. Explain why during a Full Moon phase, the Moon rises at the same time the Sun sets?

10.2 Eclipses – Eclipses occur when the Moon, Earth and Sun are aligned in a straight line (new and full moon position). The shadow from the object in the middle falls onto the one opposite the Sun.

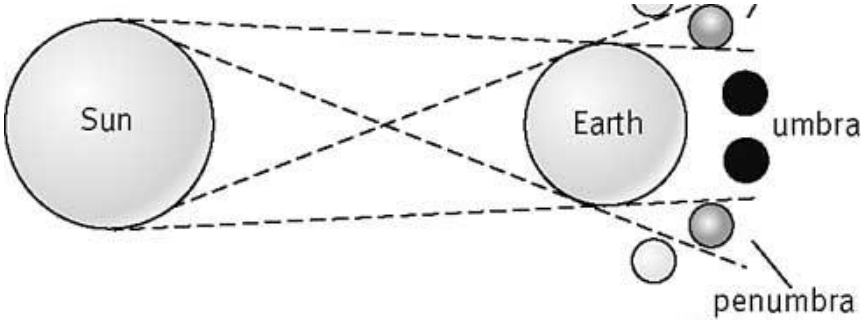
Solar Eclipse – A solar eclipse happens when the _____ moves between the Earth and Sun and the Moon's shadow is cast onto the Earth. The Moon blocks out the Sun completely or partially depending on its distance from the Earth.

- **Umbra** – Darkest part of the shadow. If an observer is in the Umbra of the shadow, they will see a _____.
- **Penumbra** – "Edge" of shadow. If an observer is the penumbra of the shadow, they will see a _____.



9. Does a solar eclipse happen on the night or day-side of Earth?

Lunar Eclipse- A lunar eclipse happens when the Moon moves behind the Earth and into _____.



10. Eclipses occur when the moon is in the new or full moon phase. The moon is in these positions twice a month, so why don't eclipses happen twice a month?

Name _____ Earth Science

Notes: Topic 10 – Beyond Earth

10.3 Tides – Tides are cyclic changes in ocean levels that are caused by the _____ gravitational pull on the Earth.

- The **gravitational** force of the Moon (and the Sun a little) **pulls** on the Earth's _____ causing the depths to change every 12 hours.

- Spring Tides – Spring tides feature the greatest range between high and low tides (highest high tide and lowest low tide). This occurs when the Earth, Moon and Sun are in a straight line (position 1 & 3 in diagram below).
- Neap Tides – Neap tides feature the smallest range between high and low tides. This occurs when Earth, Moon and Sun are at right angles to one another (position 2 & 4 in diagram below).

11. What causes the tides?

12. Draw the Earth, Moon and Sun in the correct positions to produce a spring tide.

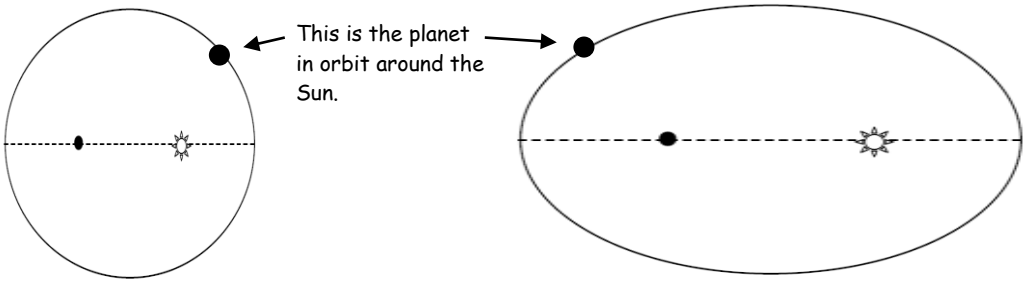
10.4 Kepler's Laws of Planetary Motion – Johann Kepler was a mathematician and he studied the orbits of the planets. He is most famous for his three astronomical laws:

Kepler's 1st Law: The orbits of the planets around the Sun are _____ with the _____ at one of the ***foci*** and nothing located at the other foci. This was a very big deal because planets' orbits were thought to be circular.

$$\text{eccentricity} = \frac{\text{distance between foci}}{\text{length of major axis}}$$

This orbit is not very elliptical and would have a calculated eccentricity closer to .001

This orbit is very elliptical and would have a calculated eccentricity closer to .999



Eccentricity values will always be between .001-.999, where the lower the value the closer the orbit is to being perfectly round.

13. Which orbit's eccentricity is closest to being a perfect circle: e = .784 OR e = .168? answer: _____

14. Which orbit is more elliptical: e = .568 OR e = .721? answer: _____

15. Given the distance between the foci = 4 cm and the length of the major axis = 12cm, what is the eccentricity of the orbit? (Show formula, substitution and 3 digit solution)

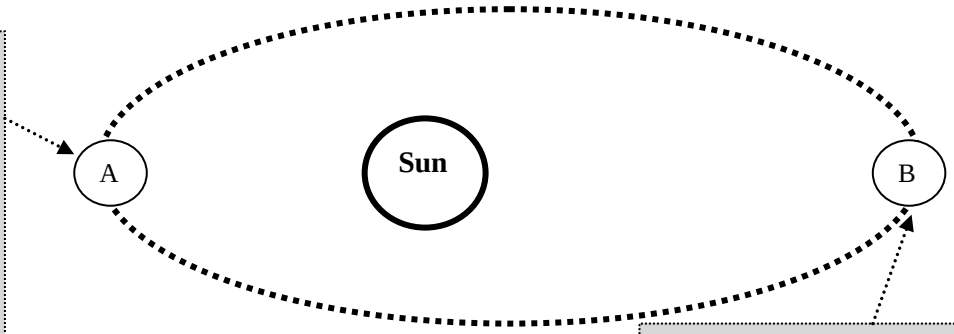
16. Given the distance between the foci = 7.2 cm and the length of the major axis = 11.5cm, what is the eccentricity of the orbit? (Show formula, substitution and 3 digit solution)

Kepler's 2nd Law of Planetary Motion: Planets **travel at different speeds at different positions of their orbit** around the Sun. When a planet is **closer to the Sun**, it travels _____ than when it is farther from the Sun.

Orbital velocity - the speed of a _____ at a specific time during it's orbit.

When Earth is closest to the Sun (like position A), it's called the _____ position.

At this location, Earth (and all planets) have their _____ orbital velocity.



When Earth is farthest from the Sun (like position B), it's called the _____ position.

At this location, Earth (and all planets) have their _____ orbital velocity.

17. Besides the changing distance, why does Earth's orbital velocity change during its revolution around the Sun?

Kepler's 3rd Law of Motion: The farther the planet is from the Sun (average radius of orbit), the longer the orbital period will be (or the planet's year).

- In other words, planets that are farther from the Sun take longer _____.

Name _____ Earth Science

Notes: Topic 10 – Beyond Earth

10.5 Isaac Newton's Universal Law of Gravitation

This law states that the gravitational force between any two objects is directly proportional to the products of their _____ and inversely proportional to the square of the _____ between their centers.

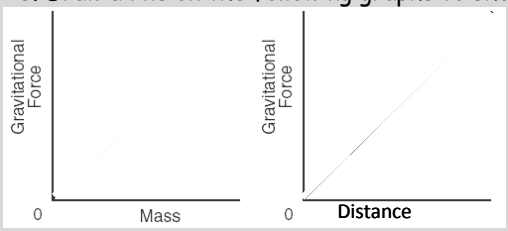
Where:
m_1 = mass of 1st object
m_2 = mass of 2nd object
r = distance between objects

$$F = \frac{m_1 m_2}{r^2}$$

18. How would the force of gravity change if the Moon suddenly was half it's mass?

19. How would the force of gravity change between Earth and the Sun if we moved Earth farther away.

20. Draw a line on the following graphs to show the type of relationship that exists.



10.6 Our Solar System and beyond (you will need to fill in whole definitions in this section)

A. The Big Bang Theory –

Brief Video explanation: Early in the universe's development, massive stars formed and exploded into supernovae which then spread heavy elements throughout the universe. Afterward, smaller stars began to form in large groups called galaxies. Notice how the galaxies are surrounded by "dark matter". We can't see dark matter, but we can calculate its presence and scientists believe it represents about 30% of the universe's mass.

Evidence of Big Bang Theory:

1) Red Shift -

2) Background Radiation –

B. Galaxies -

Types of Galaxies:

Spiral – 75% of all galaxies are spiral-shaped and this is a top view of one. We live in The Milky Way Galaxy, which is a spiral galaxy.

Top view of spiral galaxy:	Side view of spiral galaxy:

Other types of galaxies are elliptical and irregular.

Watch Galaxies colliding video and know this is the future for our galaxy and our closest neighboring galaxy, the Andromeda galaxy.

C. Stars –

D. Nebula –

E. Distances used in space:

1. Light year –

2. Astronomical Unit (AU) –

Name _____ Earth Science

Notes: Topic 10 – Beyond Earth

F. Our star (the SUN) -

1. The Sun's energy is from:

2. The Sun's surface temperature:

3. The Sun's Interior Temperature:

4. The Sun's volume:

5. Other features of the Sun:
   a) Sunspots:

   b) Solar Flares

G. Terrestrial Planets (aka inner or rocky planets)

H. Jovian Planets (aka gas giants)

ESRT page 15 "Characteristics of Stars" and "Solar System Data"

21. Define Luminosity (on chart) and compare our Sun's luminosity to Spica's.

22. On the basis of mass, color, luminosity and temperature compare Betelgeuse to 40 Eridani B.

23. What planet could float in water?

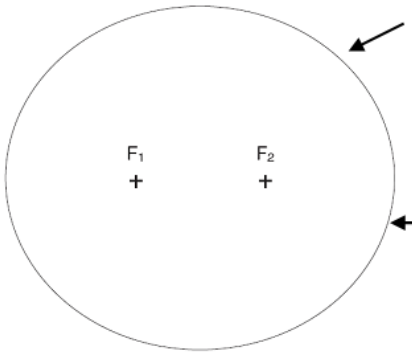
24. What planet is closest to Earth in size?

25. What planet has the most eccentric orbit?

26. Which planet has a longer day than year?

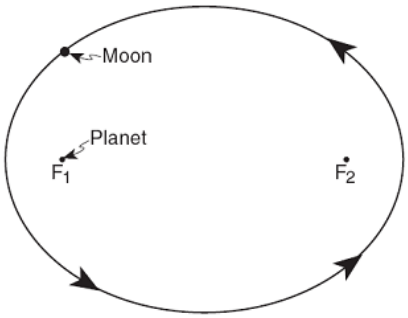
27. Which planet is considered most similar to Earth? Why?

Practice Time!



1. Calculate the eccentricity of this ellipse to the nearest thousandth. (1)

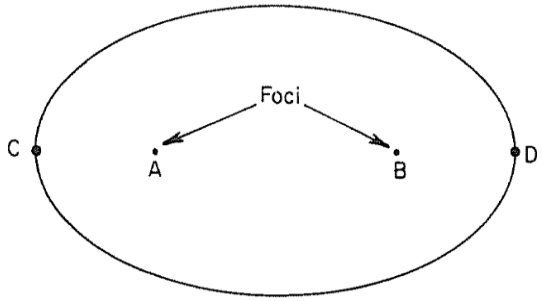
2. State how the eccentricity of this ellipse compares to the eccentricity of the orbit of Mars. (1)



(Drawn to scale)

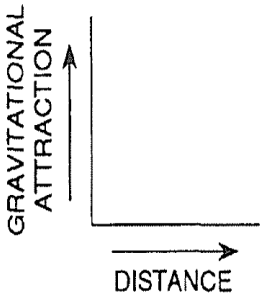
3. Calculate the eccentricity of this ellipse to the nearest thousandth. (1)

4. What is the approximate eccentricity of the ellipse shown below?

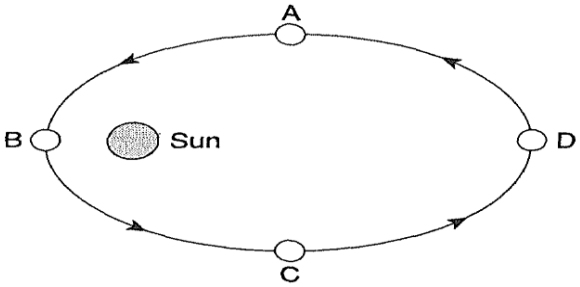


DRAWN TO SCALE

5. Draw a line on the graph to show the correct relationship between these two variables.



6. The image below shows a planet's orbit around the Sun. Answer the following questions, based on this image and your knowledge of Earth Science.



(Not drawn to scale)

a. Describe the planet's orbital velocity as it moves from position D to B.

b. Describe the force of gravity between these two objects when the planet is at position B.

c. Compared to the other locations, describe the orbital velocity of the planet at position B.

d. If a second planet had its orbit inside of this one, how would its period of revolution be different?