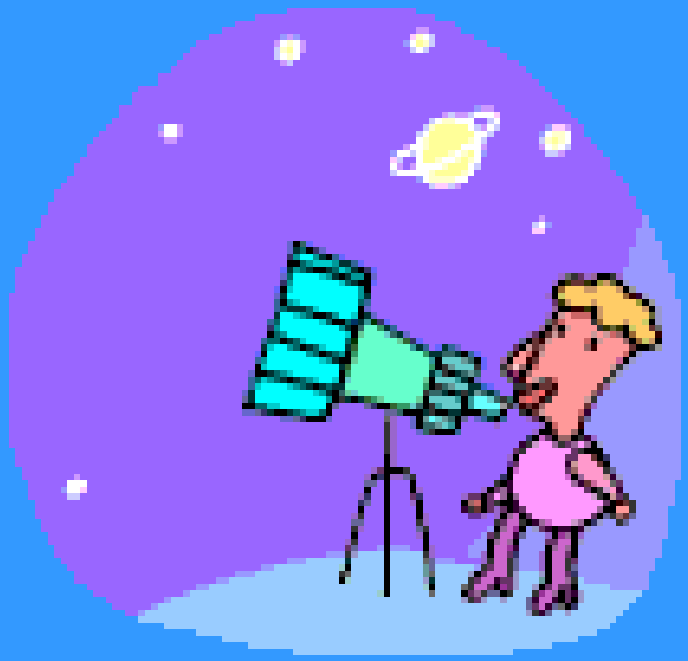
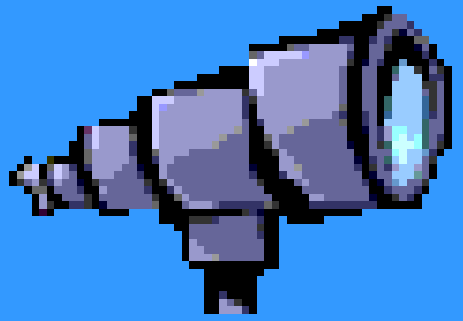
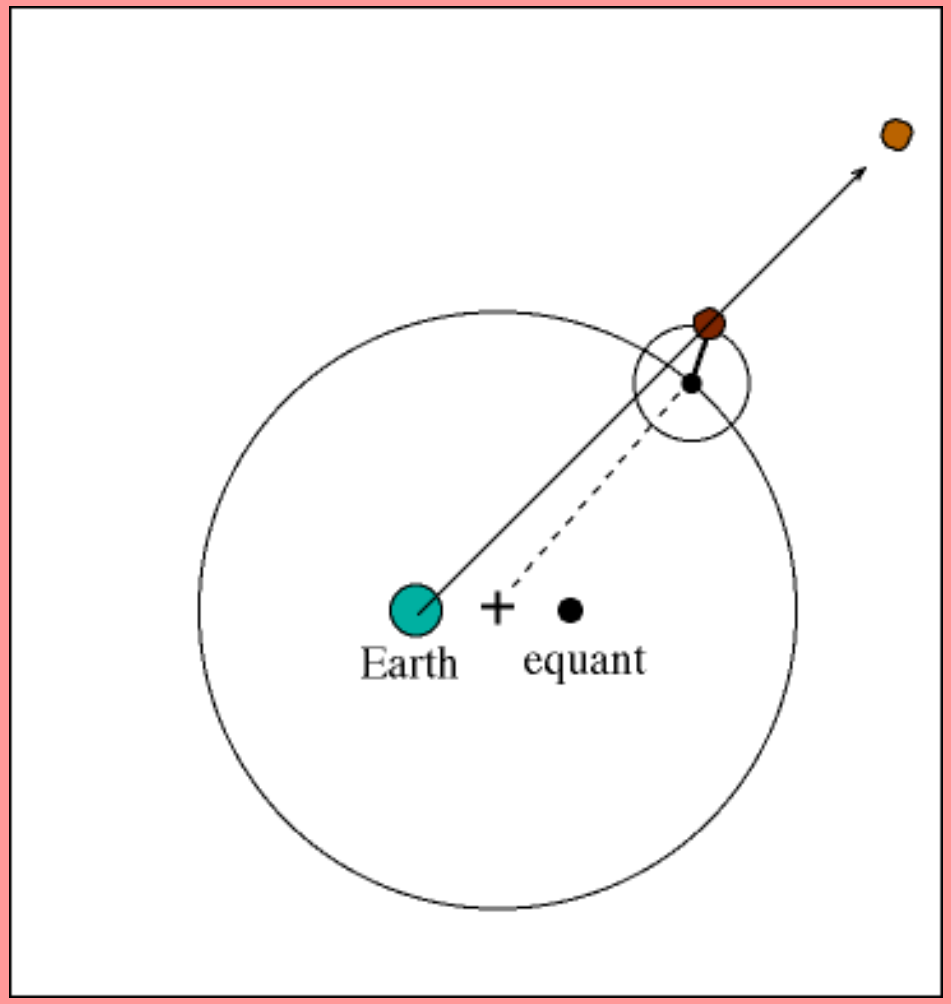
Our Solar System

Views of our solar system

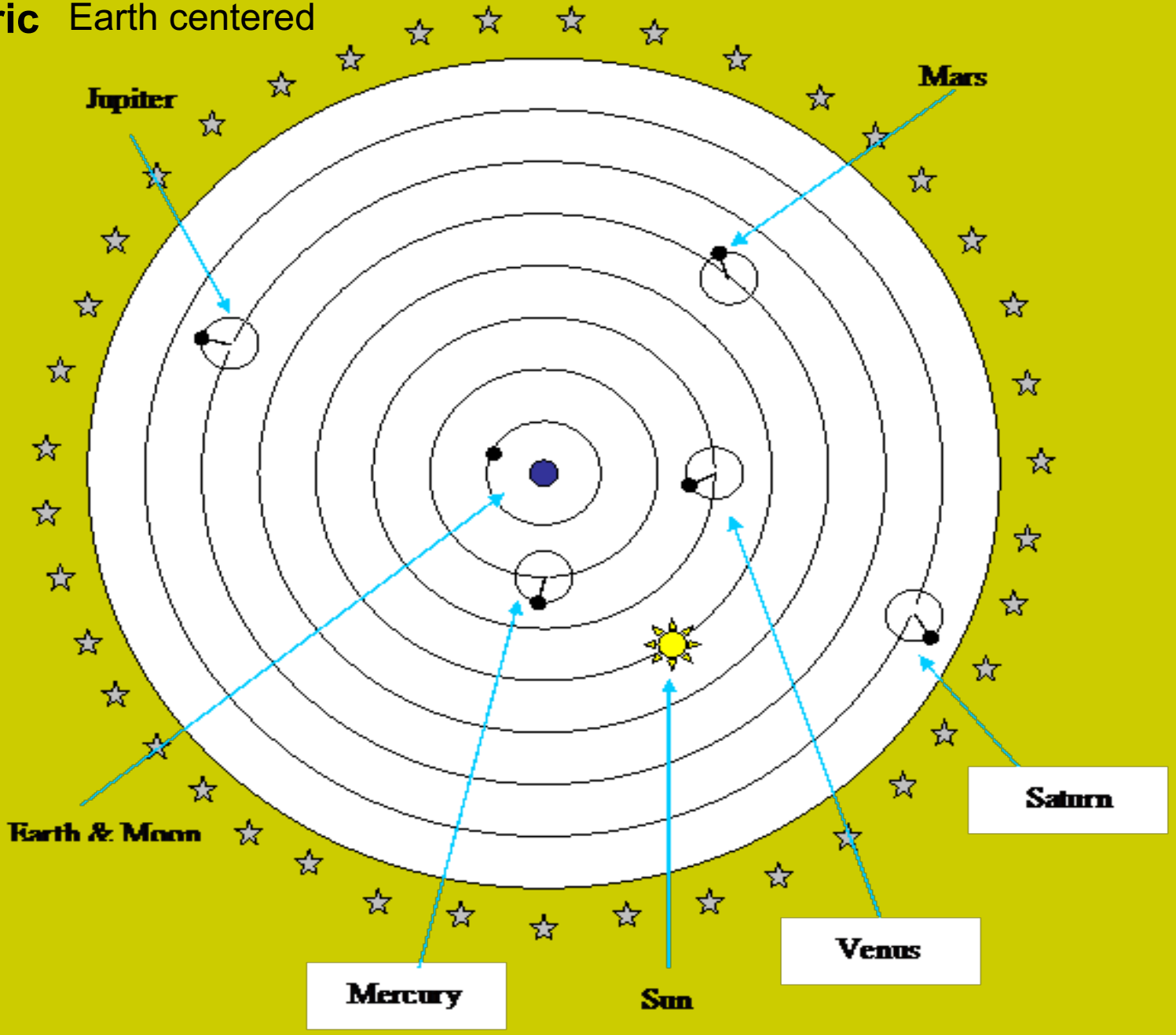




Early explanations of our solar system was thought to be a **Geocentric Model** -also called Ptolemy model
Earth was considered the center of the solar system



Geocentric Earth centered



This geocentric theory was accepted and held as true for almost 1500 years

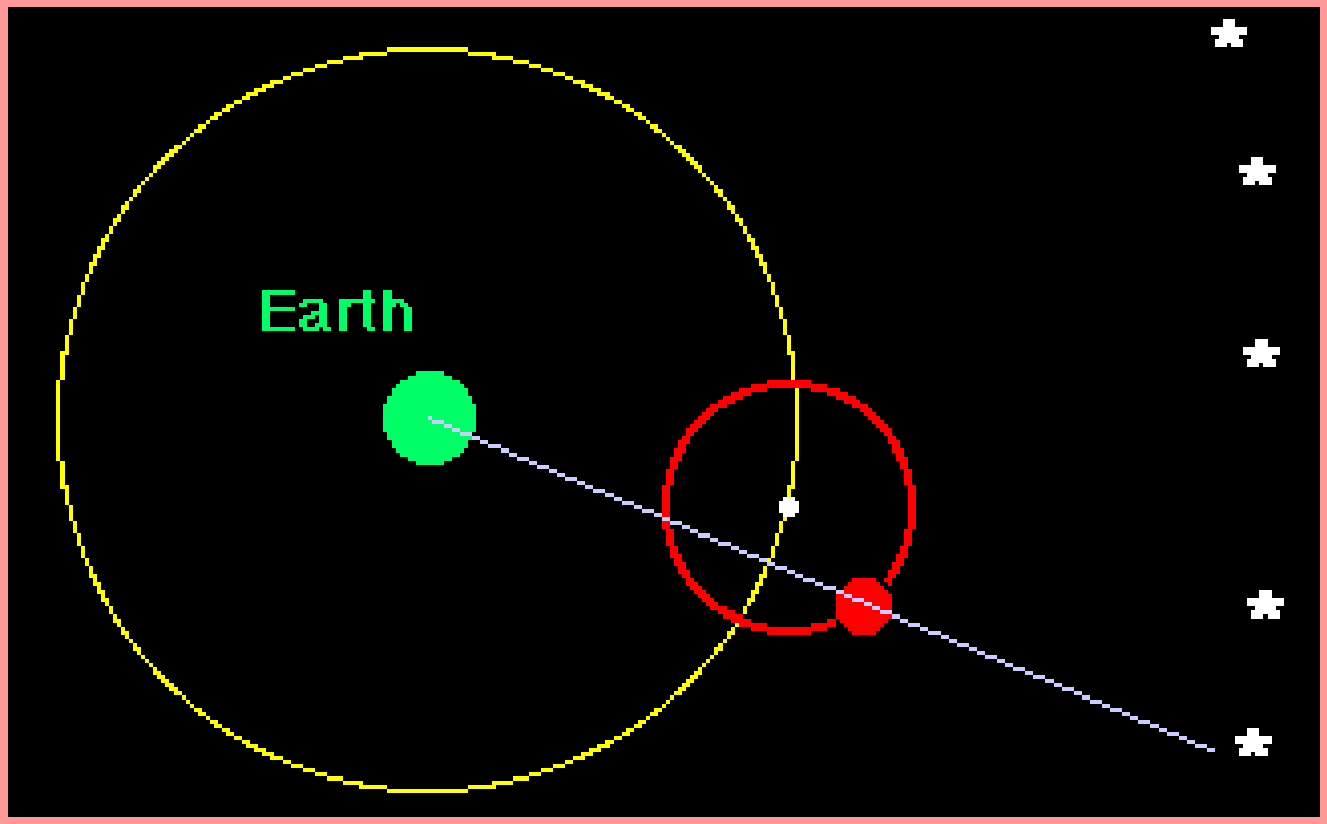
- Because of the Nature of Science, other scientists continued to research as technology increased.
- Two major problems were posed:

  1) Why did it appear that some planets would revolve in both the counterclockwise and clockwise direction? The planets for the most part appeared to revolve in a counterclockwise direction, but at times it would appear they went the other way…this was called ***Retrograde***

Ptolemy explained retrograde

- To keep his geocentric theory alive, Ptolemy explained retrograde by suggesting that within the orbit of the planets (the large circular motion around the Earth), the planets themselves made little circles called epicycles

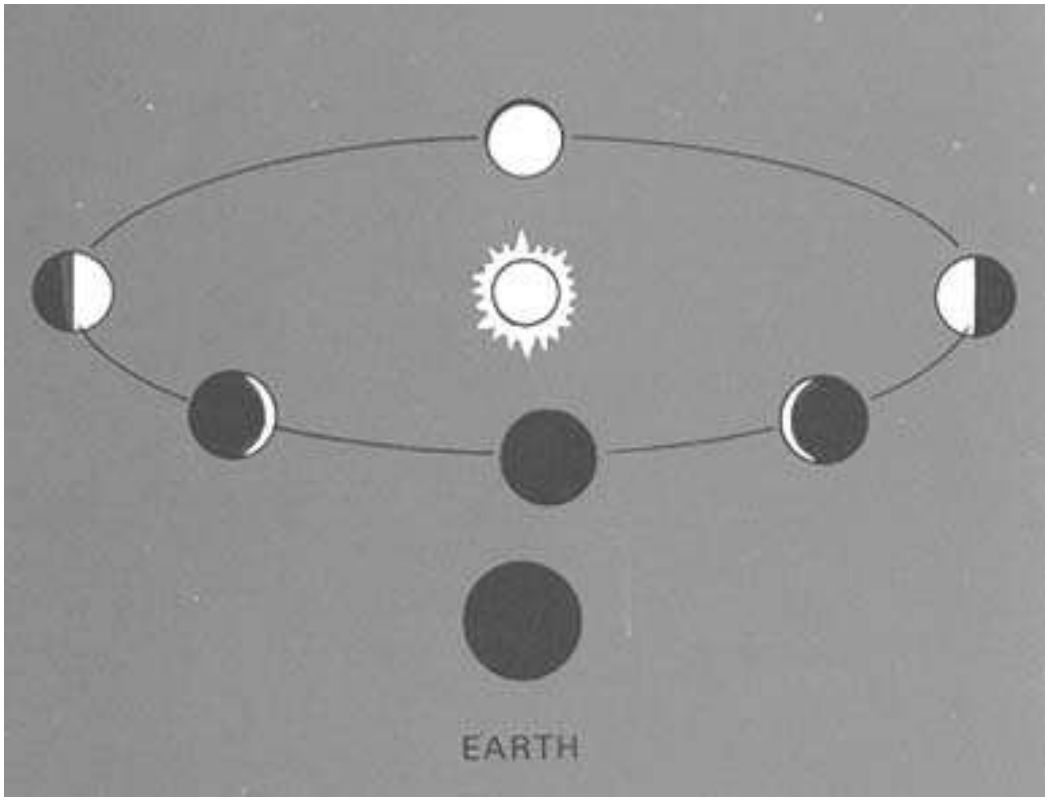
Note the red circle



The second problem was…

- If everything revolved around the Earth (including the Sun) then the planets should either be always bright, or always dark (from the viewpoint of the Earth).
- WHY do you think this must be true?
- With the aid of telescopes and increased technology once again, it was noticed that Venus had ***phases*** similar to our moon.
- What are phases?
- Phases are a change of appearance in a regularly recurring cycle

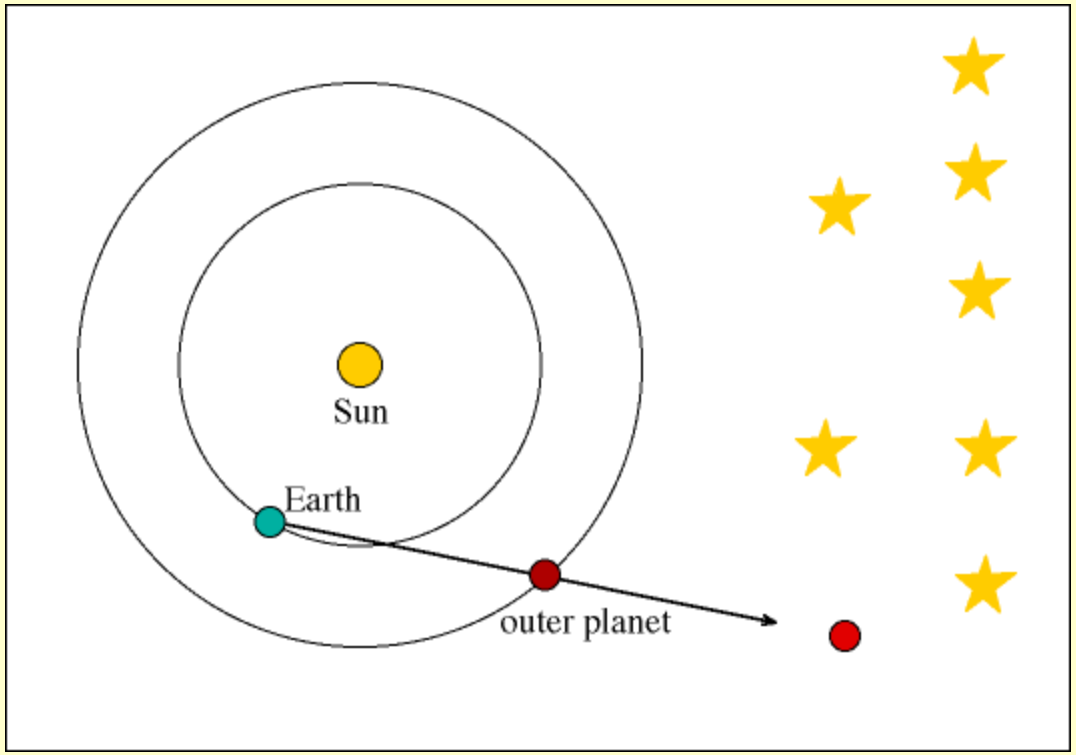
Venus phases



This discovery lead to the ***Heliocentric model***

- The prefix “Helio” comes from the Greek word Helios, which means sun.
- The idea that the sun was in the center and the planets revolved around the sun was suggested by the astronomer Nicolaus Copernicus. His explanation still stands today.

Heliocentric model

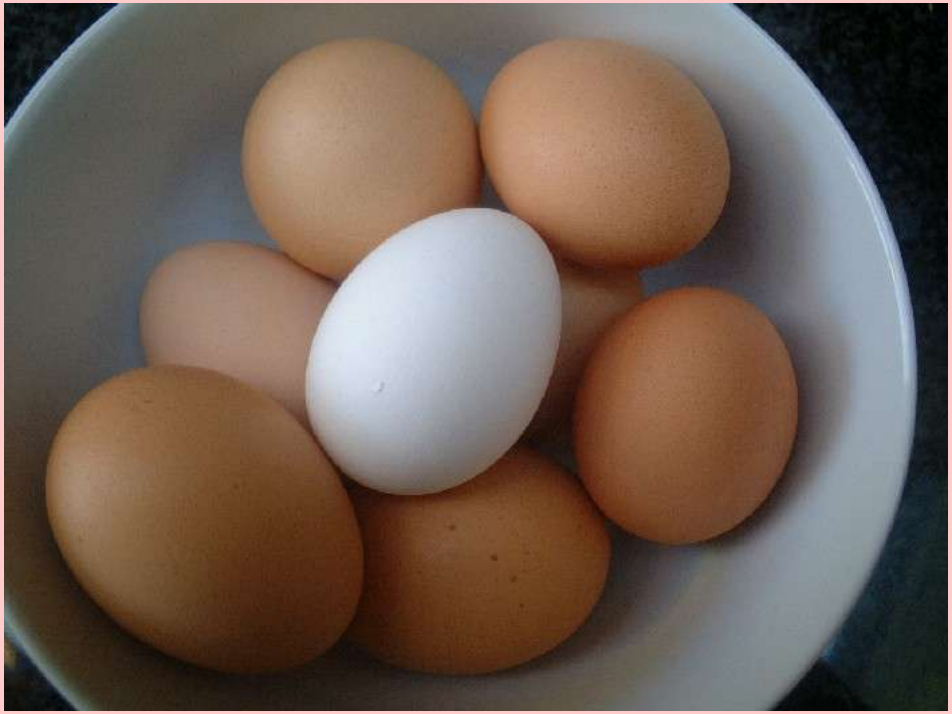


While Copernicus' explanation of what was in the center was correct…

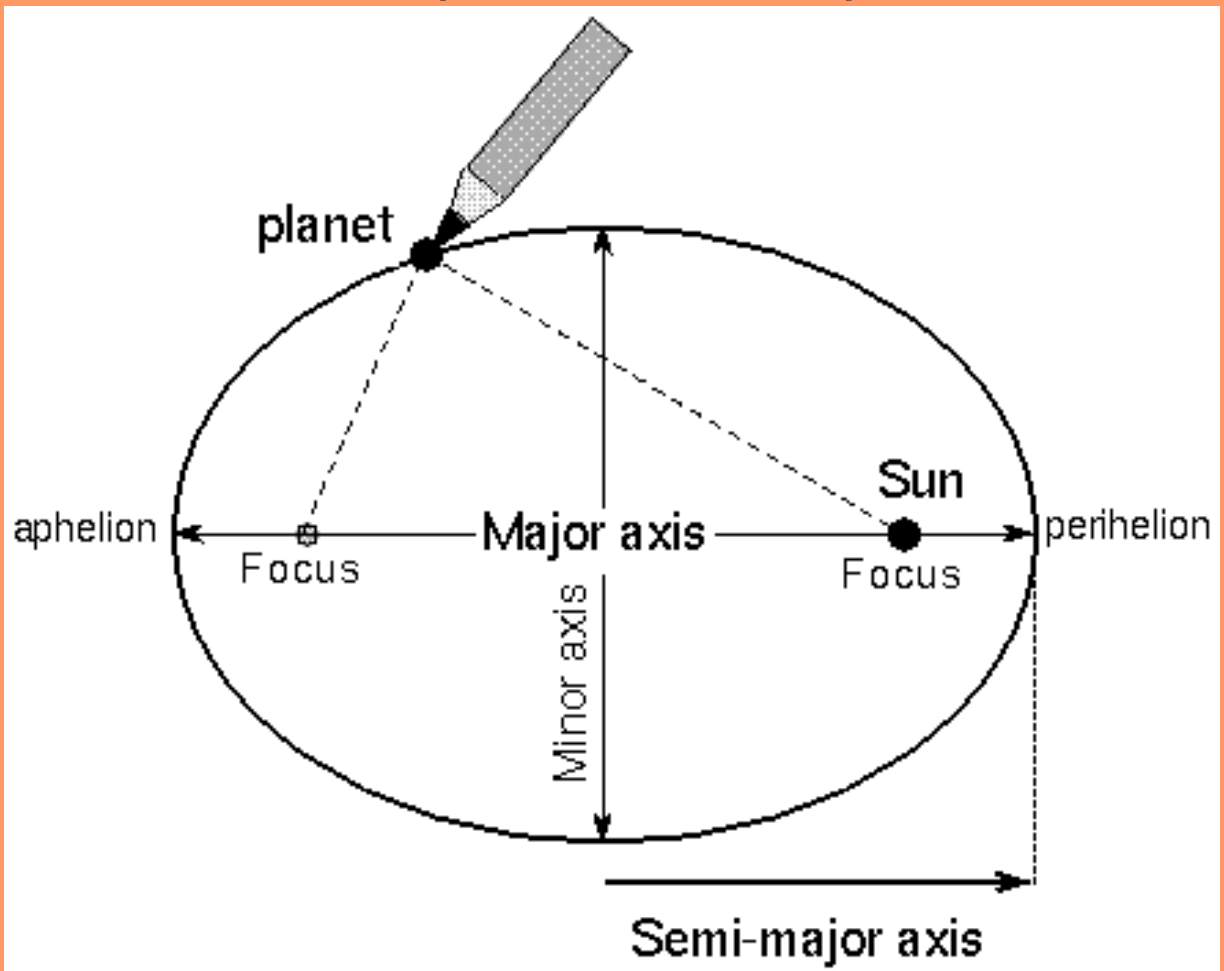
- He was wrong about the ***shape of the orbit.***
- What is an orbit?
- An orbit is the path of an object as it revolves around another object in space.
- Copernicus believed that the orbits were round, but through the research and discoveries of other scientists—specifically Johannes Kepler—it was determined that the orbits were ***ellipses.*** He figured this out using mathematics. Math and science are often used together
- What is an ellipse?

An ellipse is an elongated circle, or oval shape…

- Like a football, or an egg



This is an example of what Kepler did



Drawing an **ellipse**: loop string around thumb tacks at each **focus** and stretch string tight with a pencil while moving the pencil around the tacks. The Sun is at one focus.

***Major axis*---**the length of the longest dimension of an ellipse.

Semi-major axis---one half of the major axis and equal to the distance from the center of the ellipse to one end of the ellipse. It is also the average distance of a planet from the Sun at one focus.

***Minor axis*---**the length of the shortest dimension of an ellipse.

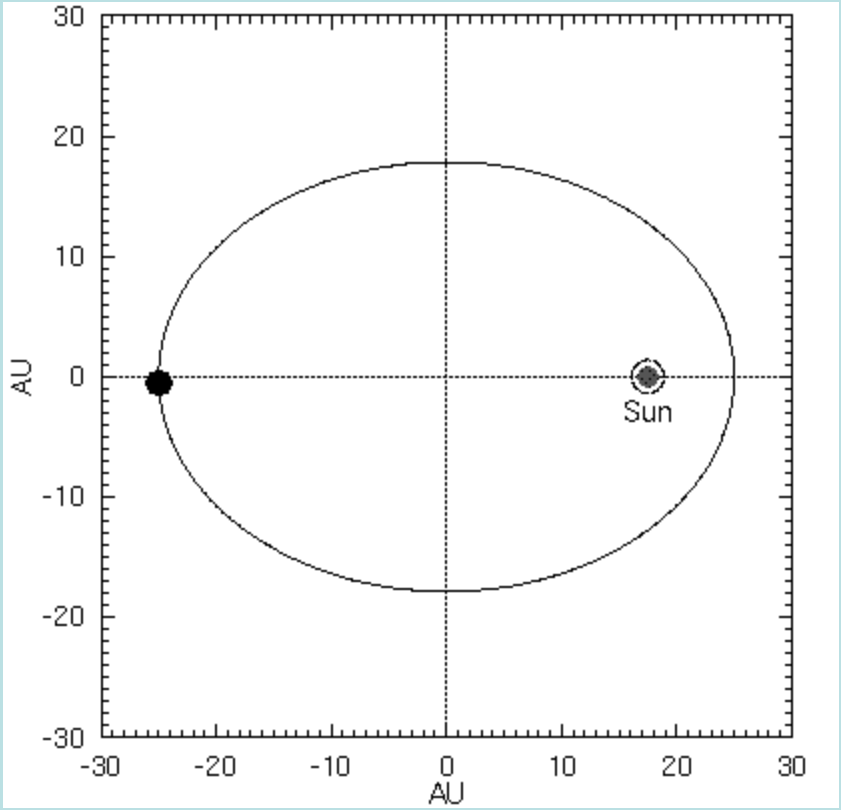
Perihelion---point on a planet's orbit that is closest to the Sun. It is on the major axis.

Aphelion---point on a planet orbit that is farthest from the Sun. It is on the major axis directly opposite the perihelion point. The aphelion + perihelion = the major axis.

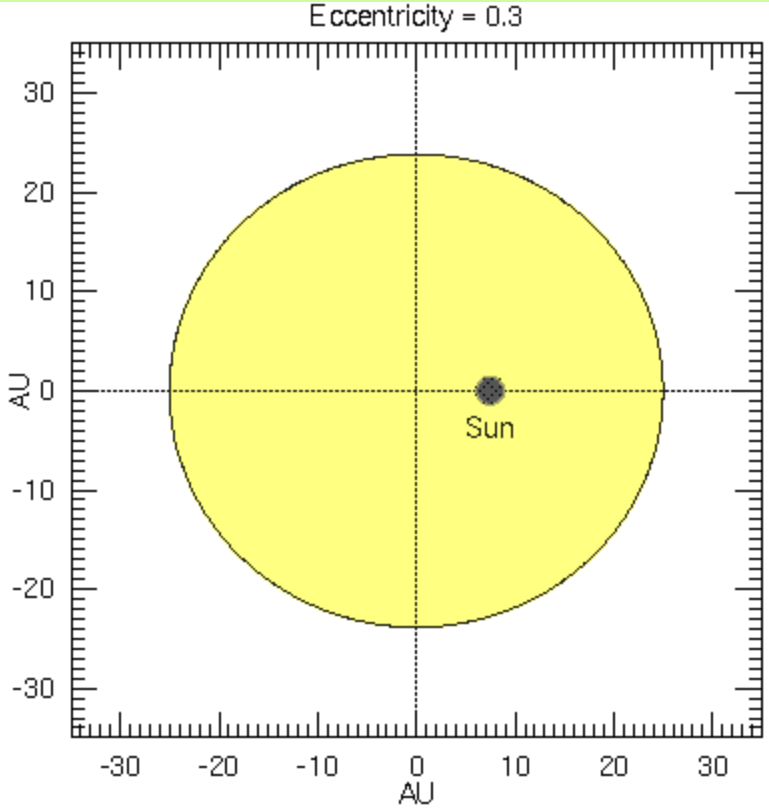
Focus---one of two special points along the major axis such that the distance between it and any point on the ellipse + the distance between the other focus and the same point on the ellipse is always the same value. The Sun is at one of the two foci (nothing is at the other one). *The Sun is NOT at the center of the orbit!*

As the foci are moved farther apart from each other, the ellipse becomes more eccentric (longer and skinnier). A circle is a special form of an ellipse that has the two foci at the same point (the center of the ellipse).

The **eccentricity** (*e*) of an ellipse is a number that quantifies how elongated the ellipse is.

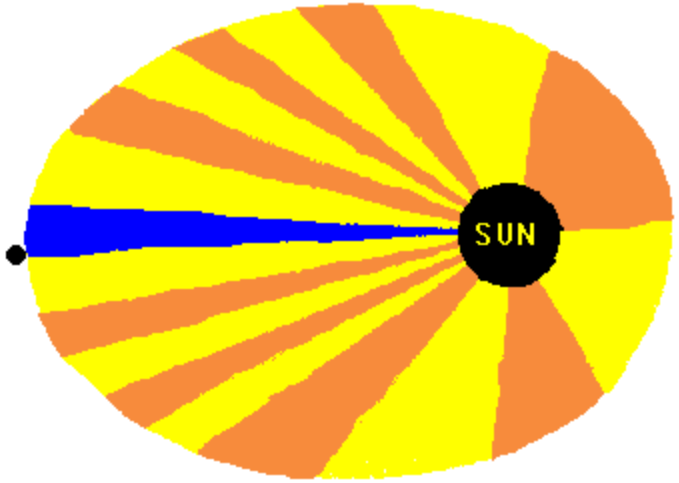

30
20
10
0
-10
-20
-30
AU
-30
-20
-10
0
10
20
30
AU
Sun

Because the ***eccentricity*** so slight is was hard to determine that the orbits were elliptical. Mathematics played the key role in this discovery.



Ellipses with the **same** *semi-major axis* (25 AU) but **different** *eccentricities*. As the eccentricity increases, the Sun (at a *focus*) moves farther from the center. The difference between the *perihelion* and *aphelion* increases as well. The ellipse with eccentricity=0.3 looks almost circular. All of the planet orbits have eccentricities **less than** 0.3—this is why it was so hard to discover that planet orbits are ellipses, rather than circles.

The planets covered the same area in the same amount of time going around the Sun, but as they came closer to the sun, they went faster. Why do you think this is so?



This is because of what we call ***Gravity.*** What is Gravity?

Gravity is the attractive force between two objects; it's magnitude depends on their masses and the distance between them.

So now we know that the planets orbit the sun, but what keeps them in orbit?

- Two things:

1) Gravity

2) Inertia

- We already know what gravity is, so what is inertia?
- Inertia is the tendency of a moving object to continue in a straight line or a stationary object to remain in place. The more mass an object has, the more inertia it has. The two scientists who discovered this were Galileo (inertia) and Sir Isaac Newton (Gravity)
- **Side note:** Einstein also has a theory about gravity—does anyone know what it is? Science never stops, as we learn more and get more technology theories can be disproved and explanations change.

Now we know our solar system consists of the planets (and other objects) revolving around the sun…

- Where is our solar system located?
- In the “Milky Way Galaxy.”


And, where are the galaxies located?
In the Universe