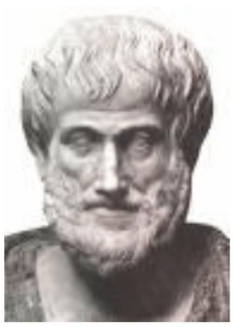
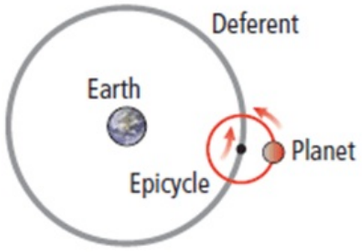
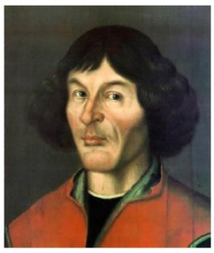
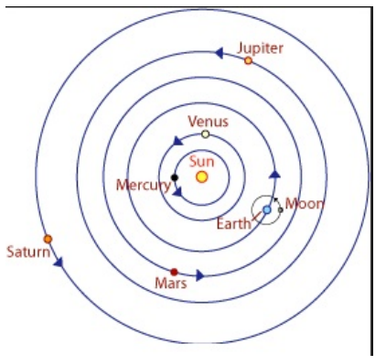
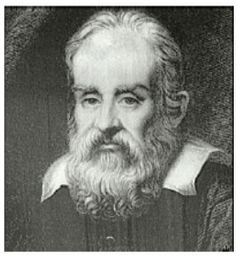
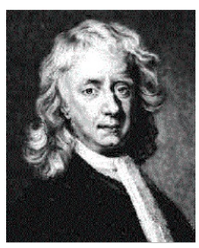
INTERMEDIATE SCIENCE 9
UNIT 1: SPACE
WORKSHEET # 4: EARLY EXPLORERS OF THE UNIVERSE

Astronomy is the study of objects and matter that lie outside the earth`s atmosphere. Without leaving the earth, astronomers explore the universe and observe how planets, stars, and other extraterrestrial phenomena are formed, how they evolve, what they are made of, how they move, and the distance between them. Outlined below are the contributions of some early explorers of the universe.

Name of Astronomer	Date	Country of Origin	Notes
1. Aristotle 	383-322B.C.E.	Greece	Geocentric universe has Earth at the centre and the Sun, Moon, planets, and stars revolving around it  He believed that the Earth was a sphere due to the curved edges observed during a lunar eclipse.
2. Ptolemy 	83-168 C.E.	Egypt	Based his model on his observations of Mars. Retrograde Motion: an apparent switch in the celestial body from eastward to westward motion, as viewed from the earth He believed that each planet revolved around a point on its orbit, called an epicycle, to explain its motion through the heavens. 

3. Copernicus 	1473-1543	Poland	Heliocentric universe the Sun was at the centre and the planets revolved around the Sun. 
4. Galileo 	1564-1642	Italy	First person to view the "heavens" through a telescope He observed: -Craters on the Moon -Spots on the Sun -Four " stars" orbiting Jupiter (called the Galilean Moons) Galileo also observed that Venus has phases, like our Moon does. This observation provided evidence for the heliocentric Now that the Sun was placed at the centre of our solar system, other astronomers could work to understand the motion of the planets. Improvements in the telescope would show new and strange objects never imagined!
5. Kepler 	1571-1630	Germany	Developed 3 Laws of Planetary Motion 1. All planets move in ellipses with the Sun at one focus 2. Planets sweep out at equal areas of their elliptical orbit in equal times. 3. The time a planet takes to revolve around the Sun is directly related to how far away it is from the Sun
6. Newton 	1643-1727	England	Considered to be the most influential scientist who ever lived Newton developed three laws to describe and predict motion, and explained how celestial bodies move through the universe. Newton was the first to show mathematically that the force of gravity extend outside of the earth (think of the visual of Newton sitting under a tree and apple hits him on the head because of gravity). Invented the reflecting telescope which uses a curved mirror to focus the light to a point at an eyepiece.

Student Activity - Easy Ellipses

Almost 400 years ago, Johannes Kepler, a German astronomer, concluded that all the planets orbit the Sun in ellipses, not circles. His studies helped explain the often confusing paths of the planets relative to each other. In this activity, you will construct a number of different-sized ellipses.

Materials:

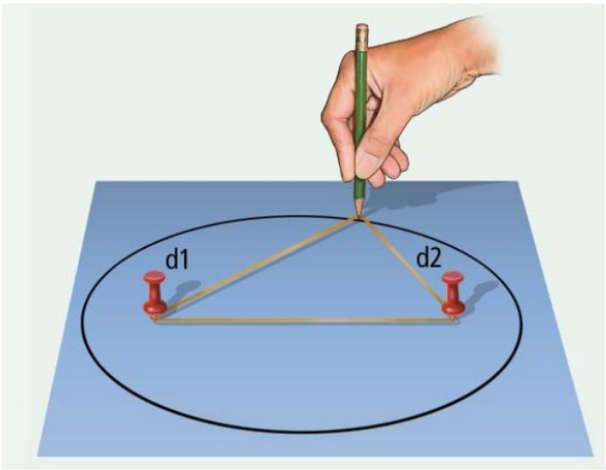
- 2 cardboard squares (30 cm 30 cm)
- blank piece of paper (28 cm 21.5 cm)
- ruler
- clear adhesive tape
- pencil
- string (or thread) about 20 cm long
- 2 pushpins

What to Do:

1. Tape the cardboard squares on top of each other and tape the paper on top.

2. Draw a 20 cm line horizontally across the middle of the paper. Stick the two pushpins on the line about 5 cm apart. These two points are the foci (singular: focus).

3. Loop the string over the pushpins. Using the pencil, pull the thread outward over the paper.



4. Keeping the string tight, drag the pencil upright around the pushpins so that it draws a smooth line on the paper.

5. Put three dots on the ellipse at three different points and label them A, B, and C.

6. Measure the distance from each dot to one focus (d_1) and then to the other focus (d_2). Record the measurements in a table (like the one below) in your notebook. **(3)**

POINT	d_1	d_2	Sum Of Distances ($d_1 + d_2$)
A			
B			
C			

7. Add up the two distances from each point and record the sums in the table.

What Did You Find Out?

1. What do you notice about the sum of the distances for each point on your ellipse? **(1)**

2. State what happens to the shape of the ellipse if you move the pushpins (foci):

   (a) farther apart? **(2)**

   (b) closer together? **(2)**

3. Calculate the sum of distances for another ellipse. **(3)**

POINT	d_1	d_2	Sum Of Distances ($d_1 + d_2$)
A			
B			
C			

4. Write a general rule for the sum of distances from any point on an ellipse. **(2)**