Investigating Planets Name:____Block:______ **E1:R3**

FYI: Planetary Orbits and FYI: Orbiting

Read FYI: *Planetary Orbits* and FYI: *Orbiting***.** As you read answer the following questions about the readings:

1. The word "orbit" is both a ________ (the path traveled by an astronomical body) and a _________ (to travel the path.
2. What shape does an ellipse approximate and what shape is it definitely not? (two answers)
3. ___________________ is a measure of how much an orbit deviates from roundness ("circleness.")
4. What is the **ecliptic**?
5. Do all the planets orbit the Sun in the same direction? Yes or No (circle one)
6. Do planets farther from the Sun orbit faster or slower? (circle one)
7. Which of the eight planets has the most eccentric orbit (least circular)?
8. What keeps the Earth orbiting the Sun?
9. For a satellite to orbit the Earth or a planet to orbit the Sun, what must be true of the satellite or planet's motion?

FYI Planetary Orbits

An **orbit** is the path traveled by an astronomical body around another, such as a planet around the sun. To orbit is to revolve or go around. The word "orbit" is thus both a noun—the path—and a verb—to travel the path.

The orbits of the planets in our solar system have various characteristics:

- The planetary orbits are **ellipses**, or ovals, not circles.
- Most of the planetary orbits, while not circles, are nearly circular. **Eccentricity** (**e**) is a measure of how much an orbit deviates from roundness. The planet Mercury has the highest eccentricity—the least circular orbit.
- The planets orbit the sun within the almost-flat plane or disk of the solar system. This plane is known as the **ecliptic**. (As viewed from Earth, the ecliptic is the apparent path of the sun over the course of a year relative to the background of stars.) Again, the planet Mercury is least like the others. Its orbit is the most tilted, or inclined, relative to the ecliptic.
- All the planets orbit the sun in the same direction. This direction is counterclockwise, if the solar system is viewed looking down on Earth's north pole.
- The orbits get farther and farther apart as distance from the sun increases. For example, the distance between the orbits of Mercury and Venus, the two planets closest to the sun, is much smaller than the distance between the orbits of Jupiter and Saturn, which are much farther from the sun.
- The speed of the planets as they orbit gets slower and slower with distance from the sun. For example, Mercury, the planet closest to the sun, is moving faster than Mars, the fourth planet from the sun, and Mars is moving faster than Neptune.
- Because planets orbit the sun at different distances and different speeds, the distance between any two planets is constantly changing.

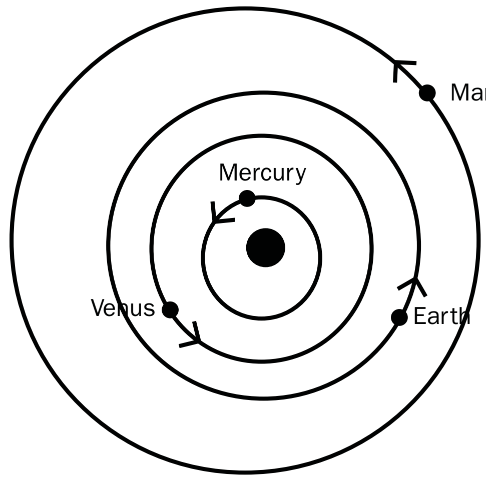

Figure 2-3: Diagram of the orbits of the planets Mercury through Mars, showing that they are very circular. Note the innermost orbit. Mercury's orbit is less circular than the others. (Sun NOT to scale; it is too large relative to the orbits.)

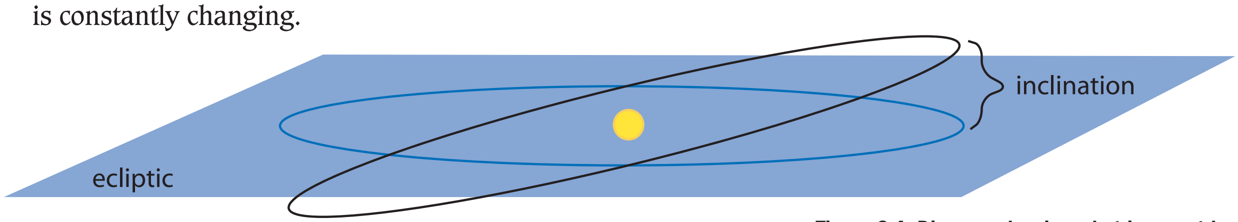

Figure 2-4: Diagram showing what is meant by an orbit that is tilted or inclined relative to the ecliptic. The orbits appear to be very elliptical because they are being viewed from an angle.

FYI Orbiting

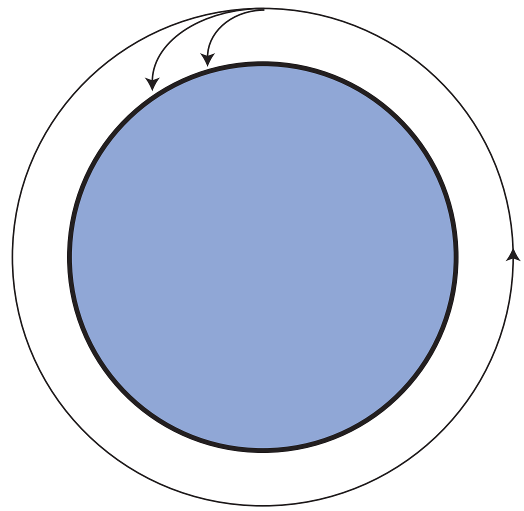

Figure 2-5: Diagram showing hypothetical paths of a ball that is dropped, thrown, and launched into orbit.

There is a significant gravitational force between Earth and the sun. It is this force that keeps Earth, and all the other planets, in orbit around the sun.

When a ball is dropped from the hand of someone who is standing on Earth, the gravitational force between Earth and the ball pulls the ball toward the center of Earth, causing the ball to fall to the ground. Now consider a thrown ball. The gravitational force between Earth and the ball still pulls the ball toward Earth, but the forward motion caused by the throw means that the ball falls to the ground at a distance from the thrower. Finally, consider a ball thrown so hard that it never falls to the ground! The gravitational force between Earth and the ball still pulls the ball toward Earth, but Earth is a sphere, and the ground curves away from the ball as it falls. The ball actually falls around the planet. It is in orbit, both pulled perpetually toward Earth and moving forward.

When the space shuttle orbits Earth, it acts like the ball that is thrown so hard it never falls to the ground. When the shuttle is launched, its path is not straight up. Instead, the shuttle climbs in a curve that gets flatter and flatter over time. The shuttle ends up having a horizontal speed of about 7.7 kilometers per second. This horizontal speed is enough to make the shuttle—like the ball described above—fall *around* the planet.

The shuttle uses rockets to propel itself into orbit, and it uses its engines to maneuver for special purposes such as docking with the International Space Station, changing to a different orbit, and beginning re-entry. The rest of the time, however, the engines are not used. The horizontal speed achieved as a result of the launch is enough to keep the shuttle falling around Earth. No horizontal force is needed once the shuttle is in orbit.

In the same way, each planet is continually falling around the sun, pulled toward the sun by the gravitational force between them but also moving at high speed along its orbital path. This combination causes the planet to stay in a uniform and unchanging orbit around the sun.