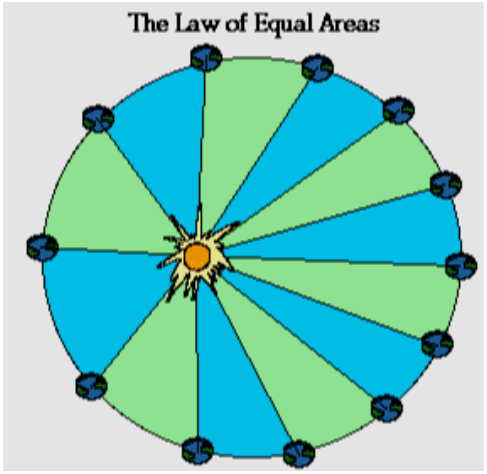
Kepler's Laws and Planetary Motion

Read from **Lesson 4** of the **Circular and Satellite Motion** chapter at **The Physics Classroom**:

http://www.physicsclassroom.com/Class/circles/u6l4a.html

MOP Connection: Circular Motion and Gravitation: sublevel 10

1. Kepler's first law of planetary motion states that ____. Choose one.
   a. the Sun is at the center of the solar system
   b. planets orbit the Sun in elliptical orbits, with the Sun located at one focus
   c. planets orbit the Sun in circular orbits, with the Sun located at the center
   d. gravity provides the force that holds the planets in orbit about the Sun



2. Kepler's second law of planetary motion states that a line connecting a planet to the Sun ____. Choose one.
   a. is longest in winter and shortest in summer
   b. sweeps out more area during a winter month than during the summer month
   c. sweeps out the same amount of area in any two equal periods of time
   d. sweeps out the same amount of area regardless of the planet.

3. A planet would move ____.
   a. at the same speed at all times during its orbit about the Sun
   b. at faster speeds when positioned closer to the Sun during its orbit
   c. at slower speeds when positioned closer to the Sun during its orbit

4. Kepler's third law of planetary motion states that the ratio of ____.
   a. the orbital period to the orbital radius is the same for all planets
   b. the orbital periods of any two planets equals the ratio of the orbital radii
   c. all planets would orbit with the same orbital period
   d. the period squared to the radius cubed is the same ratio for all planets

5. A planet that is further from the Sun would take _____ time to orbit the Sun compared to planets that are closer to the Sun.
   a. more b. less c. the same amount of

6. Planetary data for the nine planets are shown below. Radius and period data are expressed relative to the Earth's radius and period.

Planet	Period (Earth years)	Ave. Radius (astron. units)
Mercury	0.241	0.39
Venus	0.615	0.72
Earth	1.00	1.00
Mars	1.88	1.52
Jupiter	11.8	5.20
Saturn	29.5	9.54
Uranus	84.0	19.18
Neptune	165	30.06
Pluto	248	39.44

Taking two planets at a time, compare the ratio of the square of the period to the ratio of the cube of their radius.

$(T_{Mars} / T_{Earth})^2 =$	_____	$(R_{Mars} / R_{Earth})^3 =$	_____
$(T_{Jupiter} / T_{Earth})^2 =$	_____	$(R_{Jupiter} / R_{Earth})^3 =$	_____
$(T_{Neptune} / T_{Uranus})^2 =$	_____	$(R_{Neptune} / R_{Uranus})^3 =$	_____
$(T_{Pluto} / T_{Uranus})^2 =$	_____	$(R_{Pluto} / R_{Uranus})^3 =$	_____
(T_____ / T_____)^2 =	_____	(R_____ / R_____)^3 =	_____
(T_____ / T_____)^2 =	_____	(R_____ / R_____)^3 =	_____
(T_____ / T_____)^2 =	_____	(R_____ / R_____)^3 =	_____

7. Complete the following statements.

   a. If planet A is twice as far from the Sun as planet B, then the period of its orbit will be _____ times as long.

   b. If planet A is three times as far from the Sun as planet C, then the period of its orbit will be _____ times as long.

   c. If planet A is four times as far from the Sun as planet C, then the period of its orbit will be _____ times as long.

   d. If planet A is five times as far from the Sun as planet C, then the period of its orbit will be _____ times as long.

8. If a small planet were located eight times as far from the sun as the Earth's distance from the sun, how many years would it take the planet to orbit the sun. **Please Show Your Work.**

