# 15.3: Kepler's Statement of his Three Laws

**1**. The planets all move in elliptical orbits with the Sun at one focus.

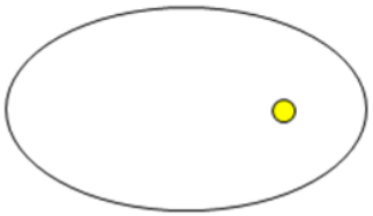

Figure 15.3.1

**2**. As a planet moves in its orbit, the line from the center of the Sun to the center of the planet sweeps out equal areas in equal times, so if the area $SAB$(with curved side $AB$) equals the area $SCD$, the planet takes the same time to move from $A$ to $B$ as it does from $CtoD$.

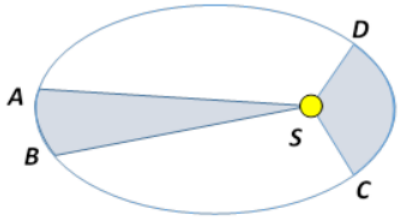


Figure 15.3.1

**3**. The time it takes a planet to make one complete orbit around the sun $T$ (one planet year) is related to the length of the semimajor axis of the ellipse $a$:

$$T^2 \propto a^3 \tag{15.3.1}$$

In other words, if a table is made of the length of year $T$ for each planet in the Solar System, and the length of the semimajor axis of the ellipse $a$, and $T^2/a^3$ is computed for each planet, the numbers are all the same.

These laws of Kepler's are precise (apart from tiny relativistic corrections, undetectable until centuries later) but they are only *descriptive*—Kepler did not understand why the planets should behave in this way. Newton's great achievement was to prove that all this complicated behavior followed from one simple law of attraction.