PhyzJob:
The Galactic Weigh Station

1. "Weighing" the Earth

A 1.0 kg mass is found to have a weight of 9.8 N, and the radius of the earth is 6.37×10^6 m; use the law of universal gravitation ($F = GMm/R^2$) to calculate the mass M of the earth (since G is now known, this calculation is possible).

2. "Weighing" the Sun

Knowing G, it was now possible to measure the mass of the sun as well. Follow these steps.

a. Write "Kepler's Rule" (Kepler's law of harmony).

b. Complete Newton's substitution $4\pi^2 K =$

c. Write an expression for K in terms of G, M, 4, and π^2.

d. Notice that you have an expression for K in part a and in part c. Equate them and solve for M.

e. If $R = 1.5 \times 10^{11}$ m and $T = 365$ d (how many seconds is that?), what is the mass of the sun?

3. How 'bout "weighing" Jupiter and Saturn while we're at it?

a. Jupiter has a moon named Europa. Europa has an orbital radius 6.88×10^8 m and a period 3.55 d. What is the mass of Jupiter?

b. Saturn has a moon named Tethys. Tethys has an orbital radius 2.95×10^8 m and a period 1.89 d. What is the mass of Saturn?

Is physics cool, or what? Measuring the force of attraction between a couple of hunks of lead made it possible to "weigh" whole planets and stars!

Check your answers with the Solar System Information Reference.