



Mars Climate Orbiter CREDIT: NASA

# Measurement Error

*Measurements are not perfect, but that's no excuse!*

A *measurement* tells us something about the property of something. It might tell us how long it is or how much it weighs. Every measurement involves two components: (1) a *number* (numerical value in a specified *system of units*) and (2) the *degree of uncertainty* associated with this estimated numerical value. Measurement instruments (and thus measurements) are not exact! The uncertainty of a single measurement from a single instrument is half the least subdivision of the instrument scale (a recognized scale unit).

Converting one measurement unit to another – for the same numerical quantity – is an essential part of measuring. Errors in unit conversion, or selection, can sometimes have significant consequences ...

On September 23, 1999 NASA lost the \$125 million Mars Climate Orbiter spacecraft after a 286-day journey to Mars. Miscommunication involving the use of English units instead of metric units apparently sent the probe slowly off course - 60 miles in all. Thrusters used to help point the spacecraft, over the mission timeline, had been firing incorrectly. The probe manufacturer's software, which was performing the calculations, was sending thruster data in non-SI units (pounds) to NASA, while NASA's navigation team was expecting SI units (Newtons). The spacecraft encountered Mars on a trajectory that brought it too close to the planet, causing it to pass through the upper atmosphere and disintegrate!