

## A Question of Some Gravity

The year 2009 is the International Year of Astronomy to commemorate the 400th anniversary of Galileo's use of a telescope to study celestial objects orbiting around a planet and star. Sir Isaac Newton later explained that the "gravity" is responsible for motions of all objects in the skies.

Here is a challenge. Two astronauts are accidentally left in space 5m apart while working on the space station. The gravitational force acting on each other can eventually bring them closer together! *Estimate how long it would take for them to reunite using the laws of motion and gravitation.* 

The Laws of Motion: Under gravity, the positions (x) and speed (v) of each astronaut changes by,

- $\Delta x = v \Delta t$  --- Equation 1
- $\Delta v = a \Delta t$  ---- Equation 2

where v and a are their speed and acceleration at any given time t, and  $\Delta t$  is a time step which needs to be specified by you ("the experimenter"). *Hint:* choose the units carefully.

The Law of Gravitation: According to Newton's law of gravity, the acceleration due to gravity is inversely proportional to the square of the distance between two bodies (r) and proportional to the mass of the other body (M) causing the acceleration. This can be expressed as

 $a = GM/r^2$  --- Equation 3

where  $G=6.67 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$ .

If we specify the initial positions and velocities ( $x_0$  and  $v_0$ ) for each astronaut, we can predict the motion of the two astronauts by keeping track of their positions and speeds.

PROCEDURES: select two "astronauts" from your group, place them 10m apart and initially stationary (not moving). Assume that they both weigh 100 kg. Astronauts need to keep track of their positions and speeds. Other members should compute how far each astronaut should move ( $\Delta x$ ) and update their speed ( $\Delta v$ ) at each time step ( $\Delta t$ ) using Equations 1-3. Repeat this procedure until the two astronauts finally meet, say 1 m apart. When you are done, report the time it took for the two astronauts to reunite.

SCORING: The team who gets the answer closest to the correct answer will win this challenge.

MEASURED TIME (in days with 1 significant figure; i.e., 1.0 days) =

SCORE = Difference between measured and correct time (in days) =

Team Name: \_\_\_\_\_