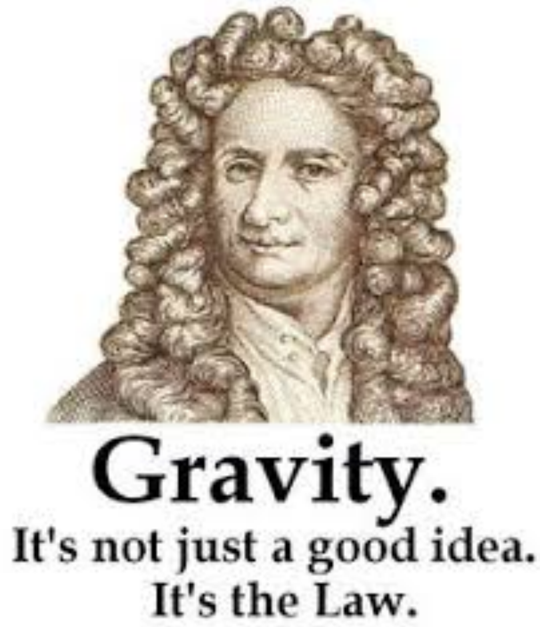
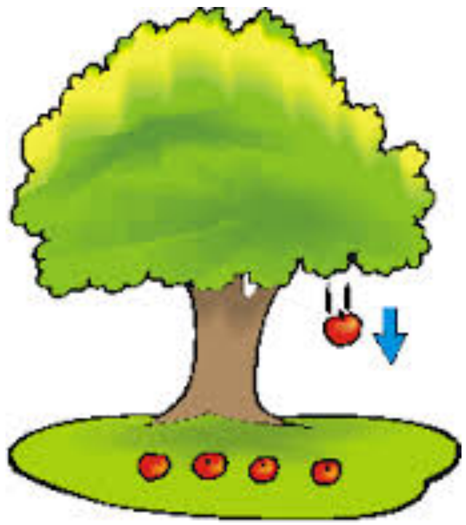
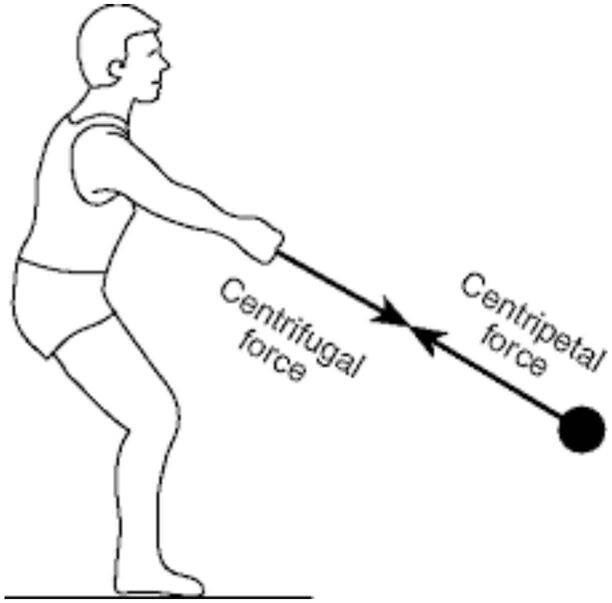
Chapter 9
Gravitation



What makes things fall down?
What keeps the moon in orbit around the earth?
What keeps the earth in orbit around the sun?





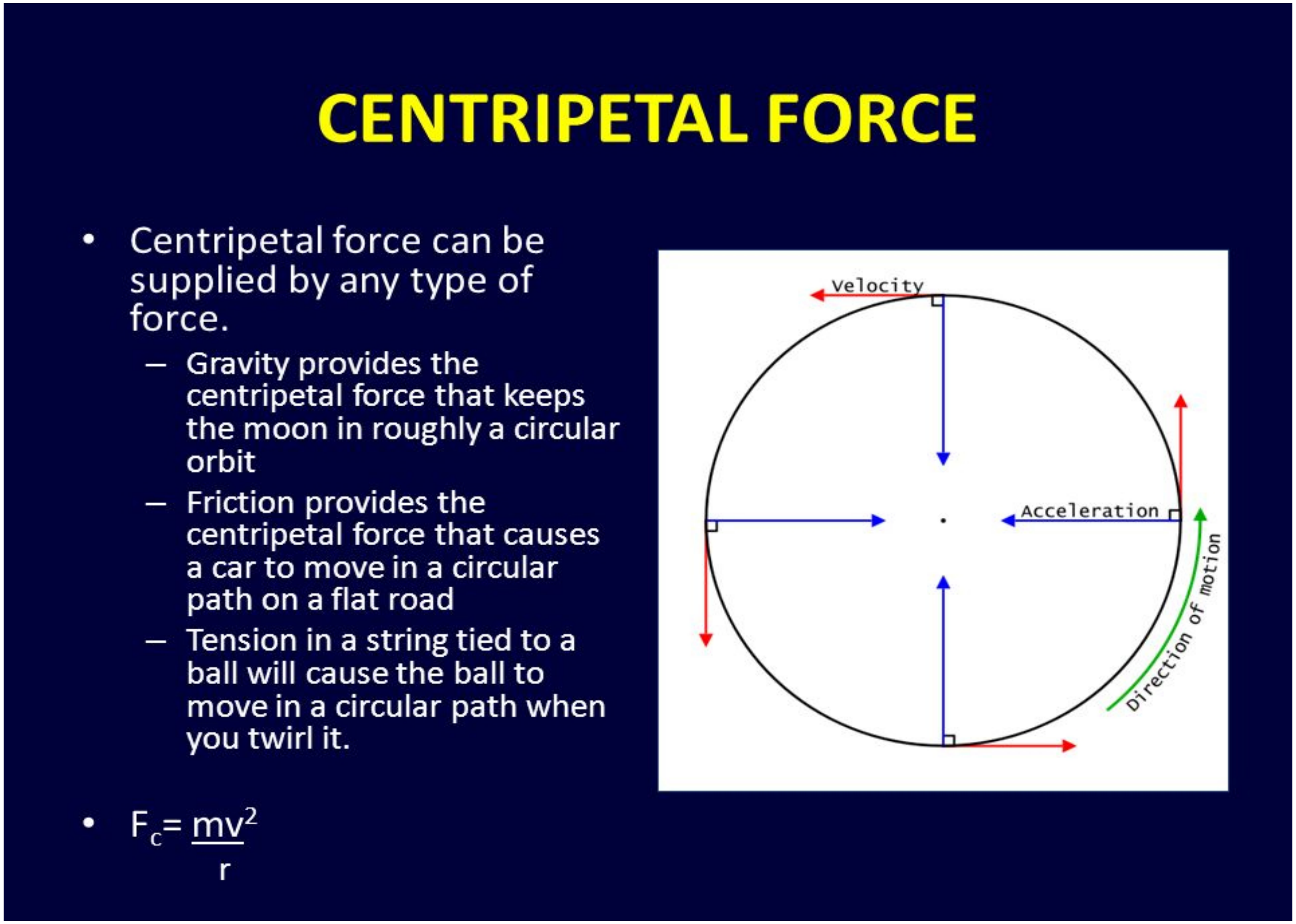
Fc = m v2/r

We know:

Centripetal force is needed to keep a thing moving in a circle.

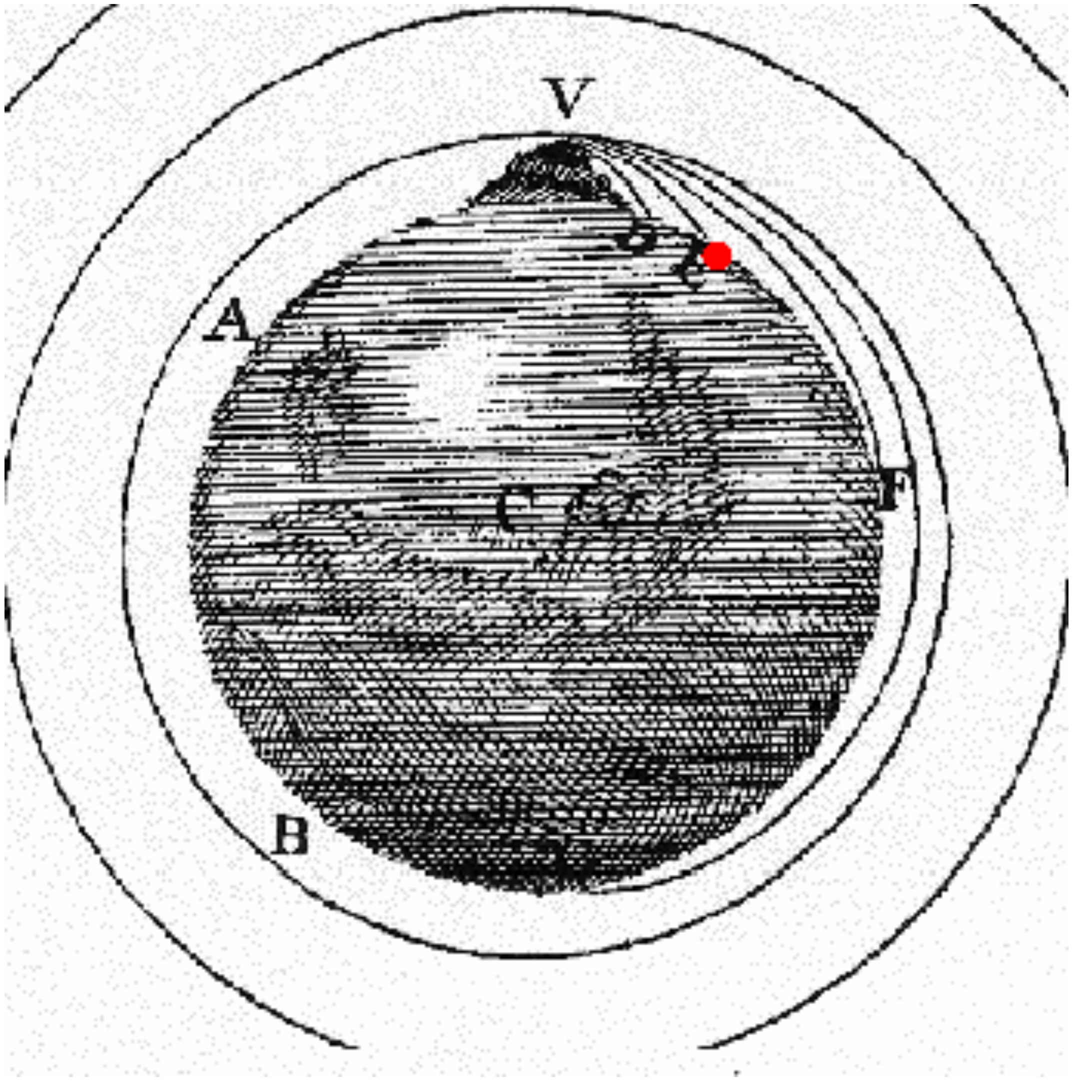
Centripetal force is proportional to the mass and is directed toward the center of the circle. Planets move in roughly circular orbits. What force is keeping them in orbit?

Circular motion requires constant acceleration
centripetal acceleration $a_c = v^2/r$
since force = mass * acceleration
centripetal force $f_c = mv^2/r$



So we actually have two problems:
1. Why do things fall down
2. Why do the planets stay in orbit. (What supplies the centripetal force?)

With ONE ANSWER:
GRAVITY.



http://galileoandeinstein.physics.virginia.edu/more_stuff/flashlets/NewtMtn/home.html

Law of Universal Gravitation

Newton's "guess”

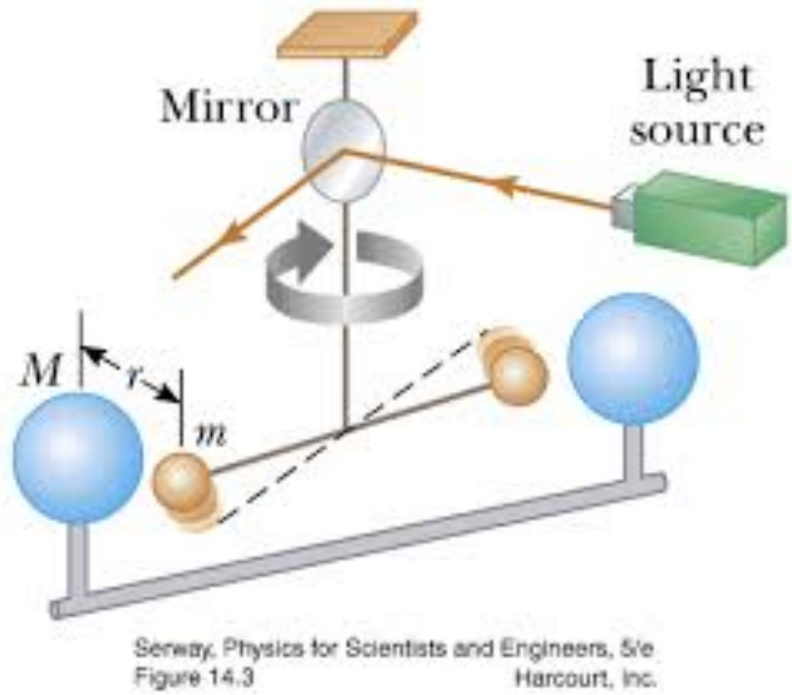
$$F = \frac{G\, m1m2}{r^2}$$

But we need to find the
value of G which is called the
Universal Gravitational Constant!

The Cavindish Experiment

Newton proposed his equation in 1687. More than 100 years elapsed before G was measured by Henry Cavindish.

G = 6.67 x10-11 N m^2 /kg^2



Inverse Square Law

If the distance doubles, the force.......

If the distance halves, the force ....

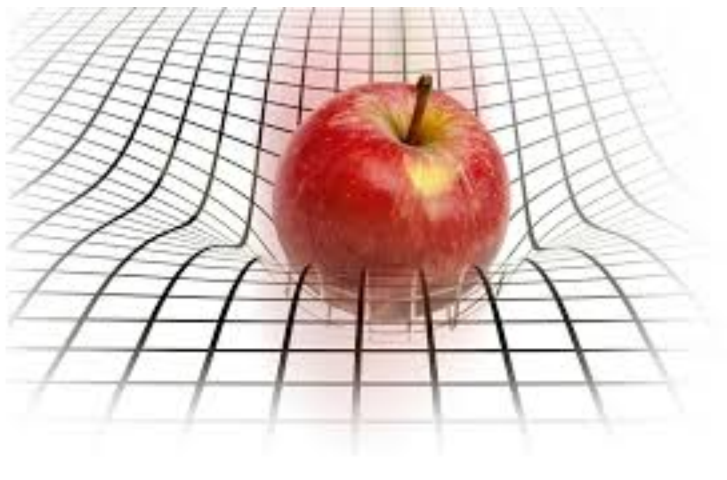
If the distance triples, the force ......

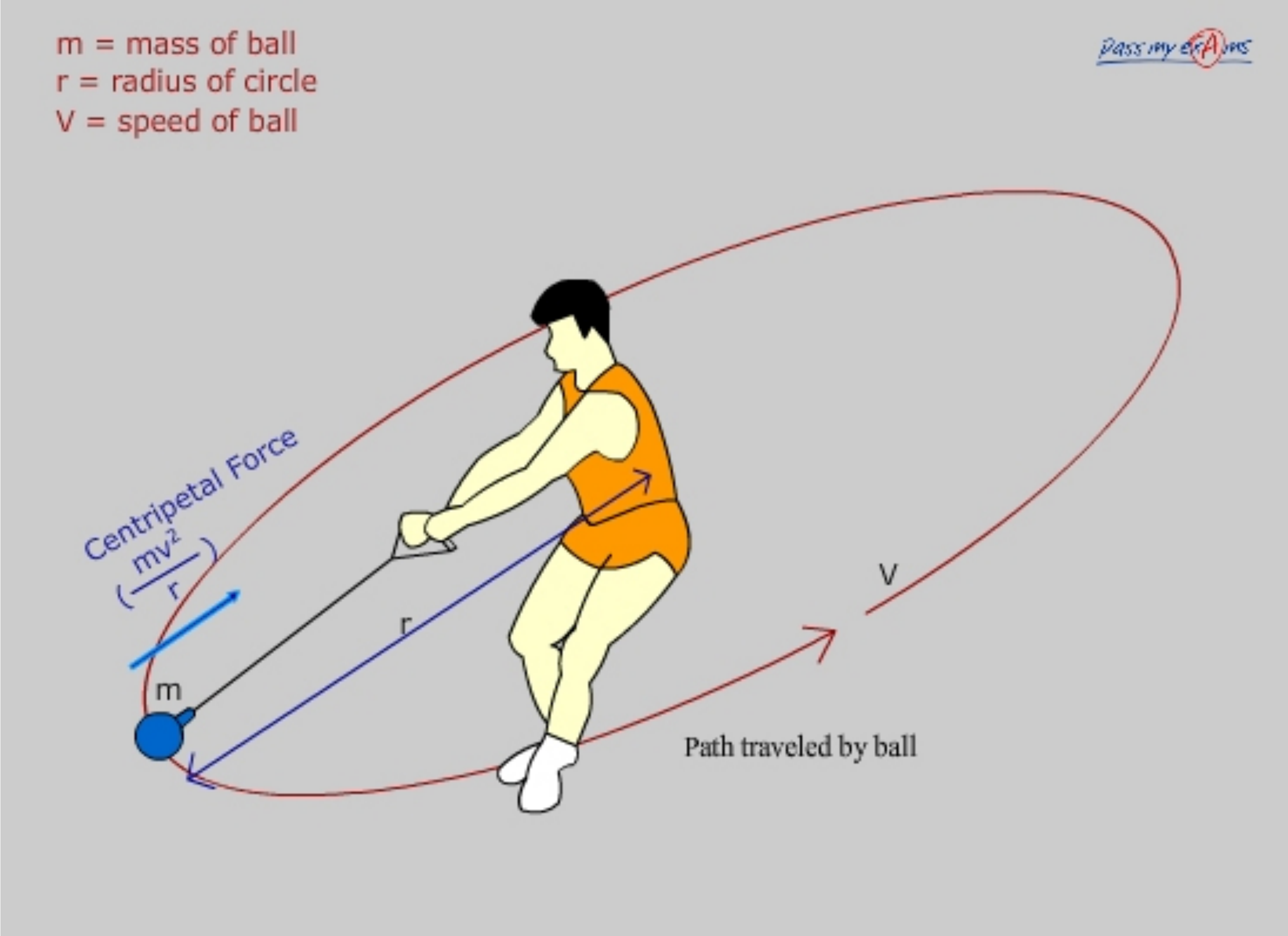
If the distance is 1/3, the force ......

Problems:

Calculate the force of gravity on a 1 kg mass at the earth's surface. Assume the mass of the earth is 6 $\times 10^{24}$ kg and the radius of the earth is 6.4 $\times 10^{6}$m.

If you moved so that you were 6.4 $\times 10^{6}$m above the surface of the earth, what would be the force of gravity on that mass?




m = mass of ball
r = radius of circle
V = speed of ball
Centripetal Force
($\frac{mv^2}{r}$)
m
r
V
Path traveled by ball