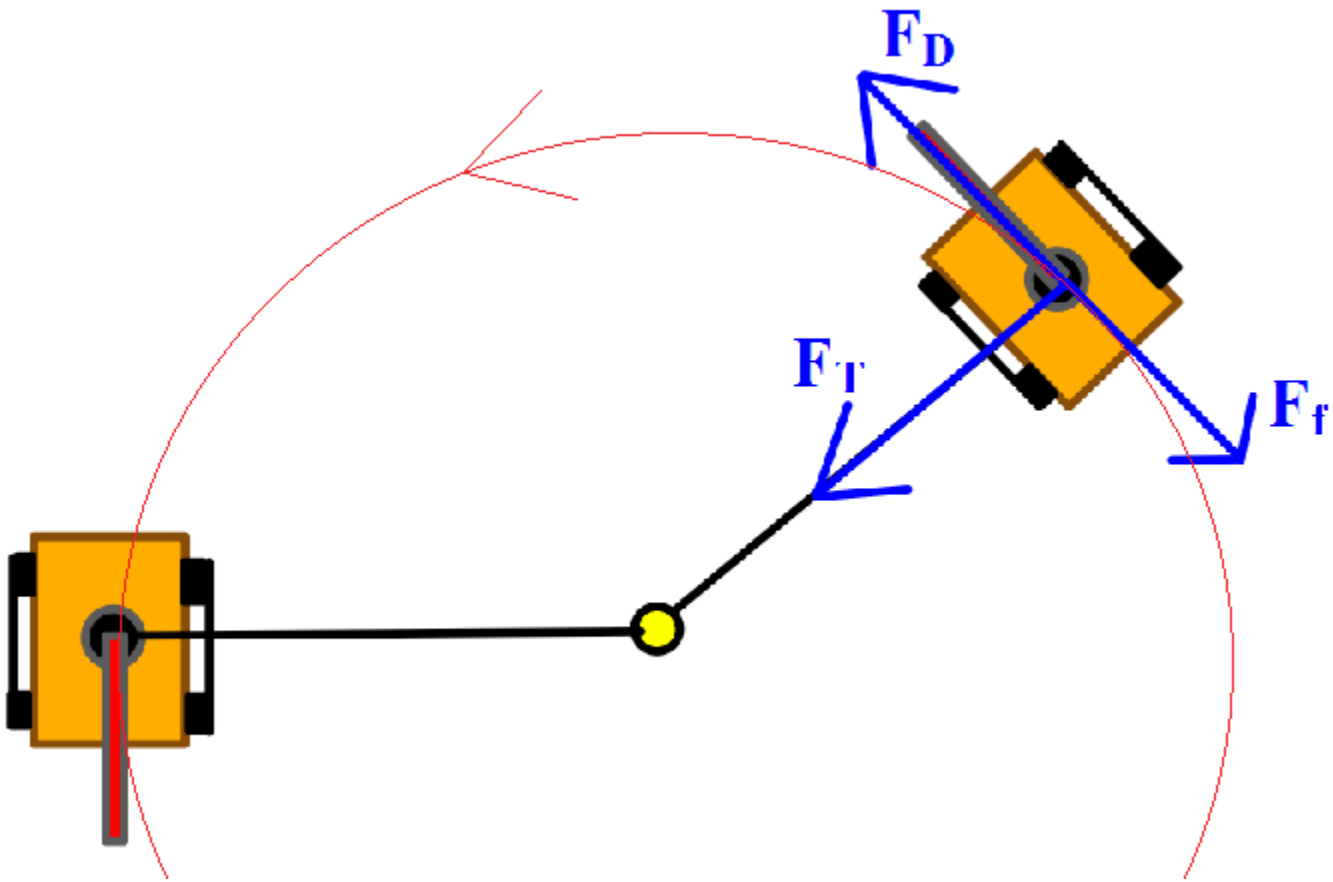
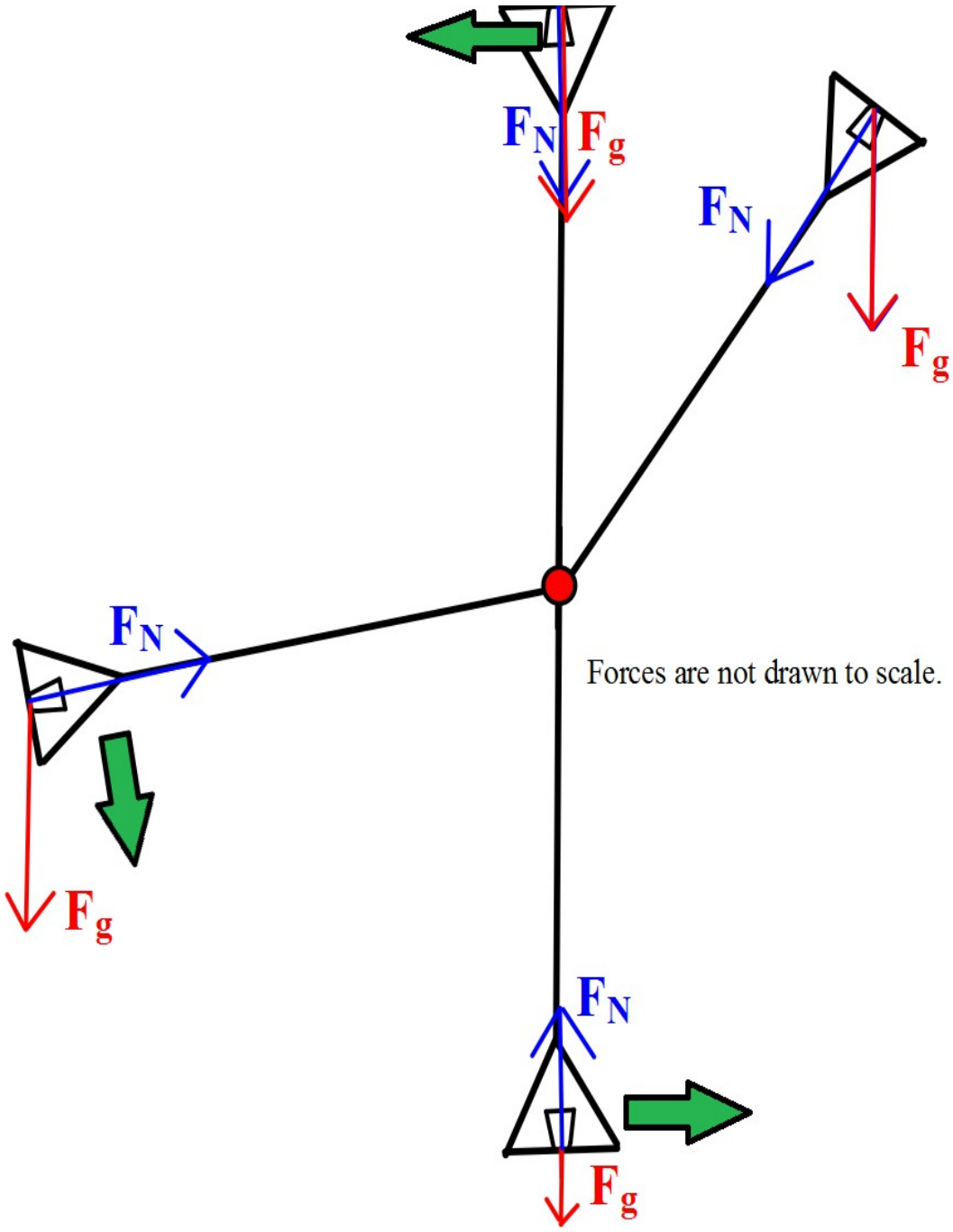
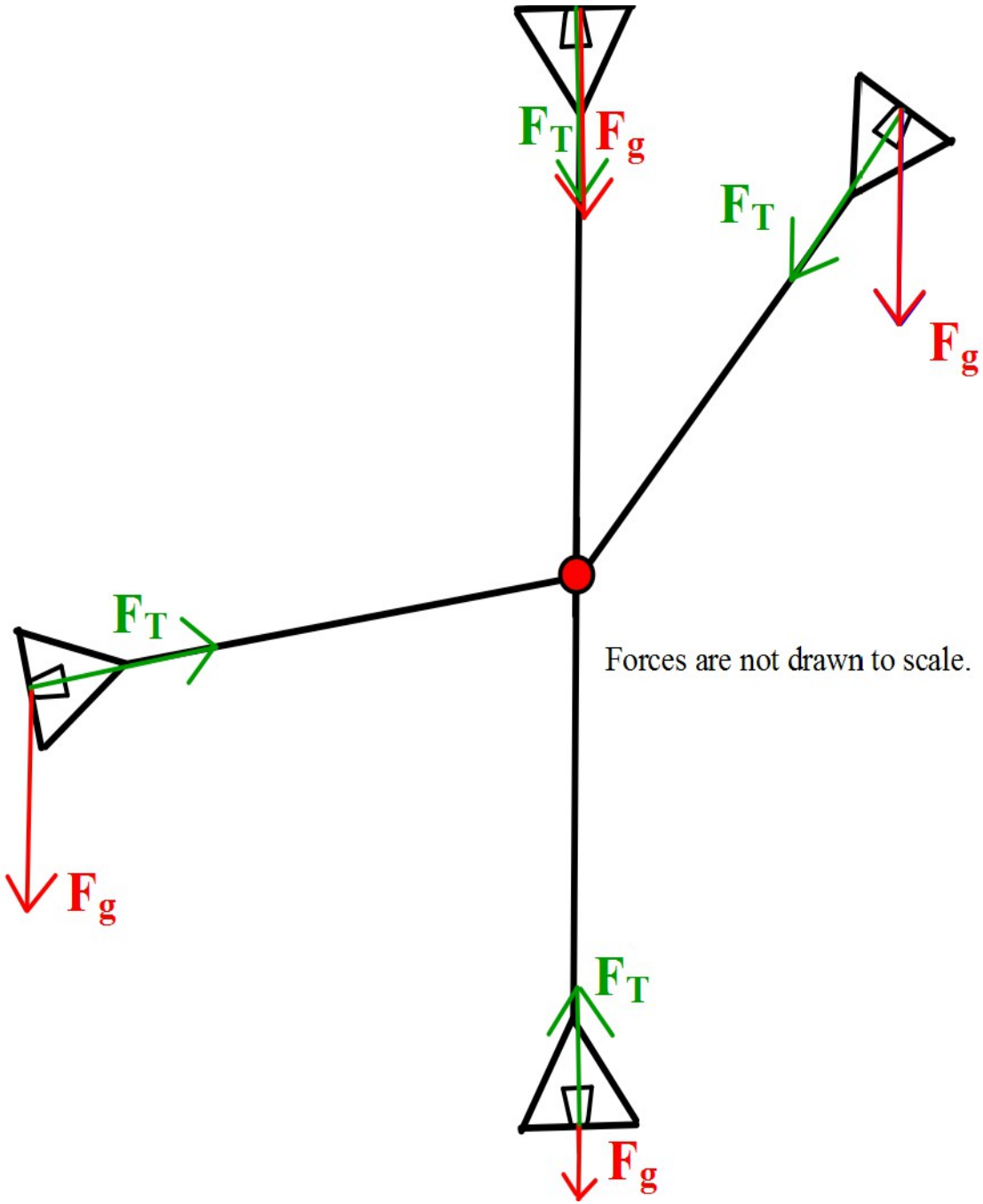
Circular Motion

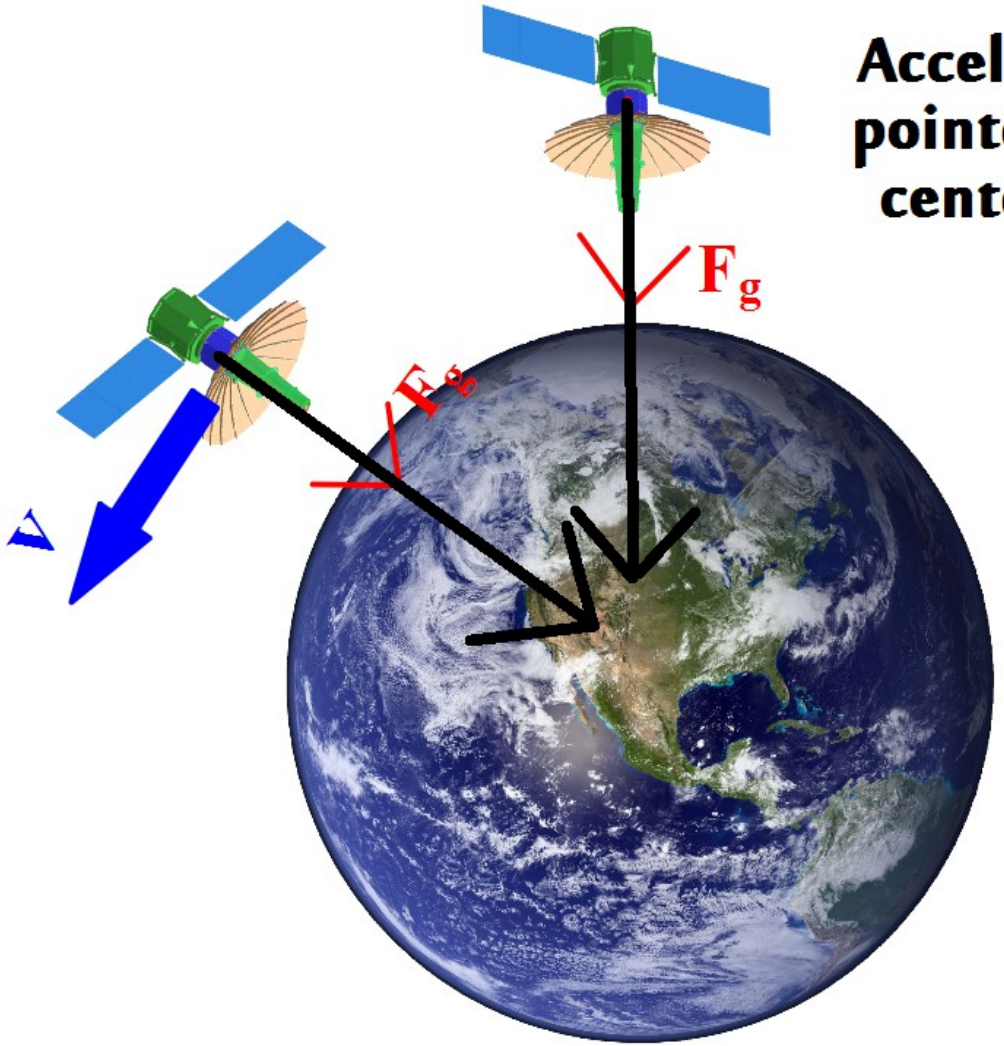

F_D
F_T
F_f

Centripetal force is the force that acts towards the center of the circle, that keeps the object moving in a circle.


F_N
F_g
F_N
F_g
F_N
F_g
F_N
F_g
Forces are not drawn to scale.


F_T
F_g
F_T
F_g
F_T
F_g
F_T
F_g
Forces are not drawn to scale.

NEVER label F_c



Acceleration pointed towards center of circle

$$F_c = \frac{mv^2}{r}$$

F_c = centripetal force (N)

m = mass (kg)

v = velocity (m/s)

r = radius (m)

$$a_c = \frac{v^2}{r}$$

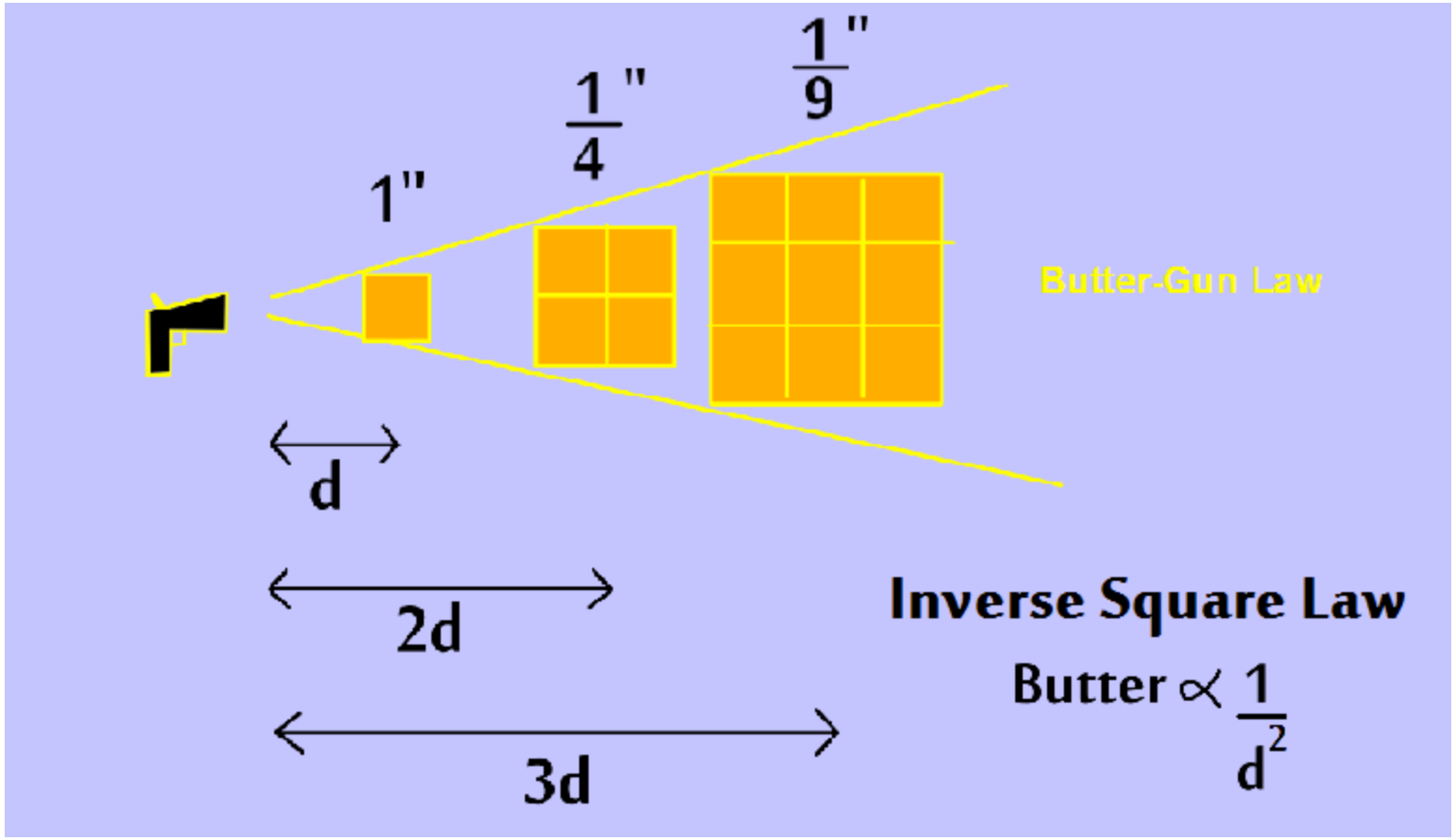
a_c = centripetal acceleration (m/s^2 or m/s/s)

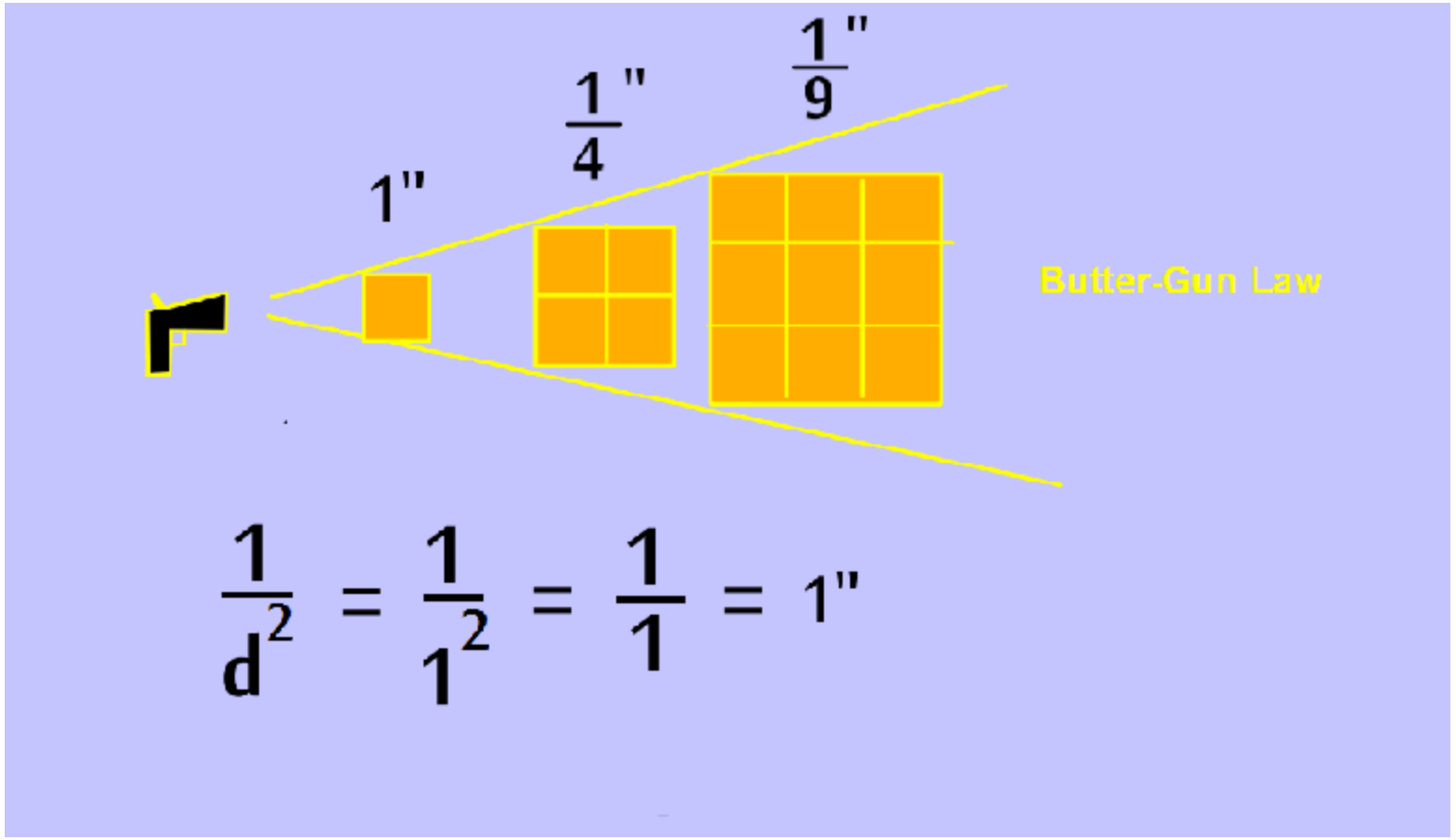
v = velocity (m/s)

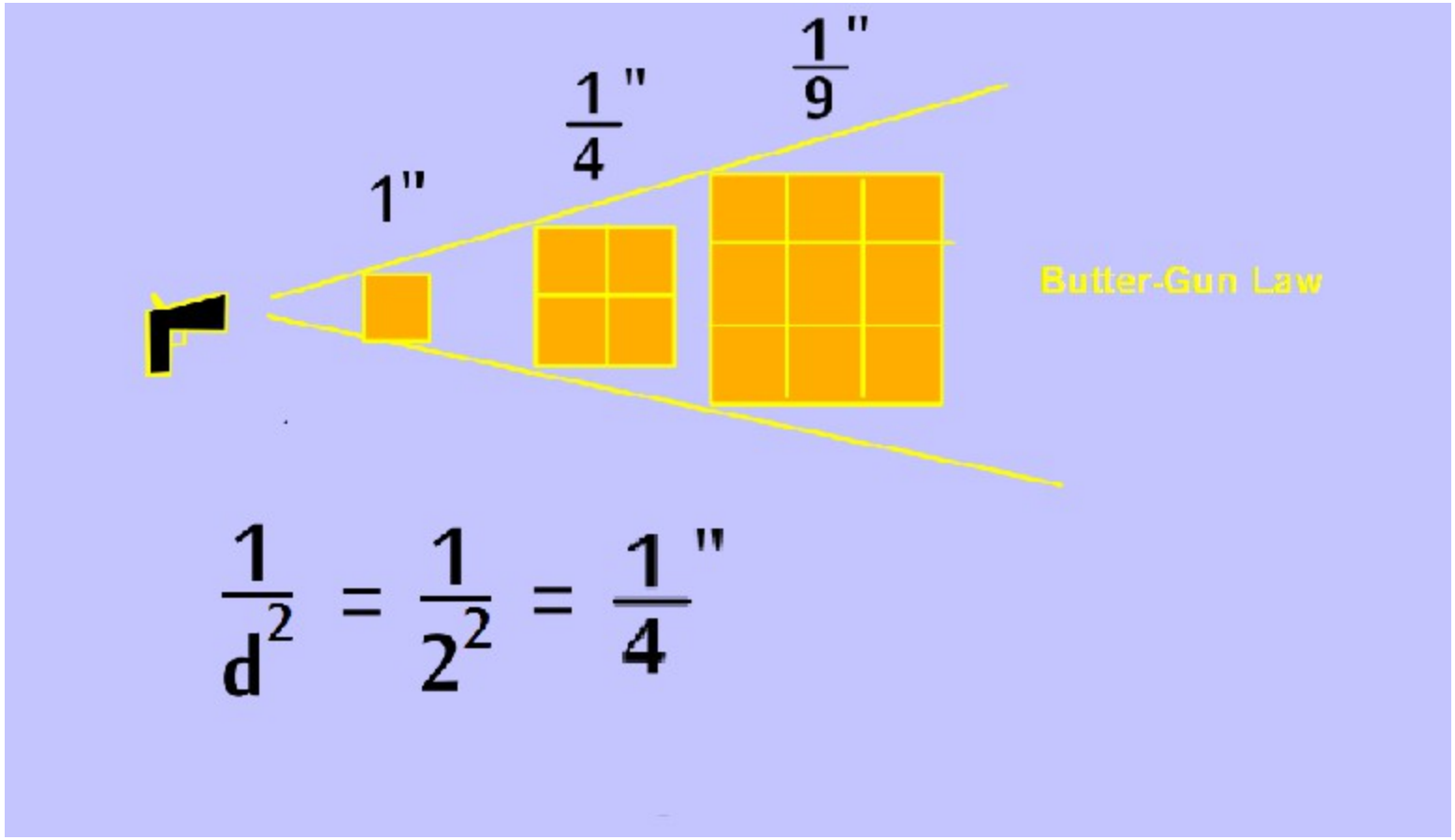
r = radius (m)

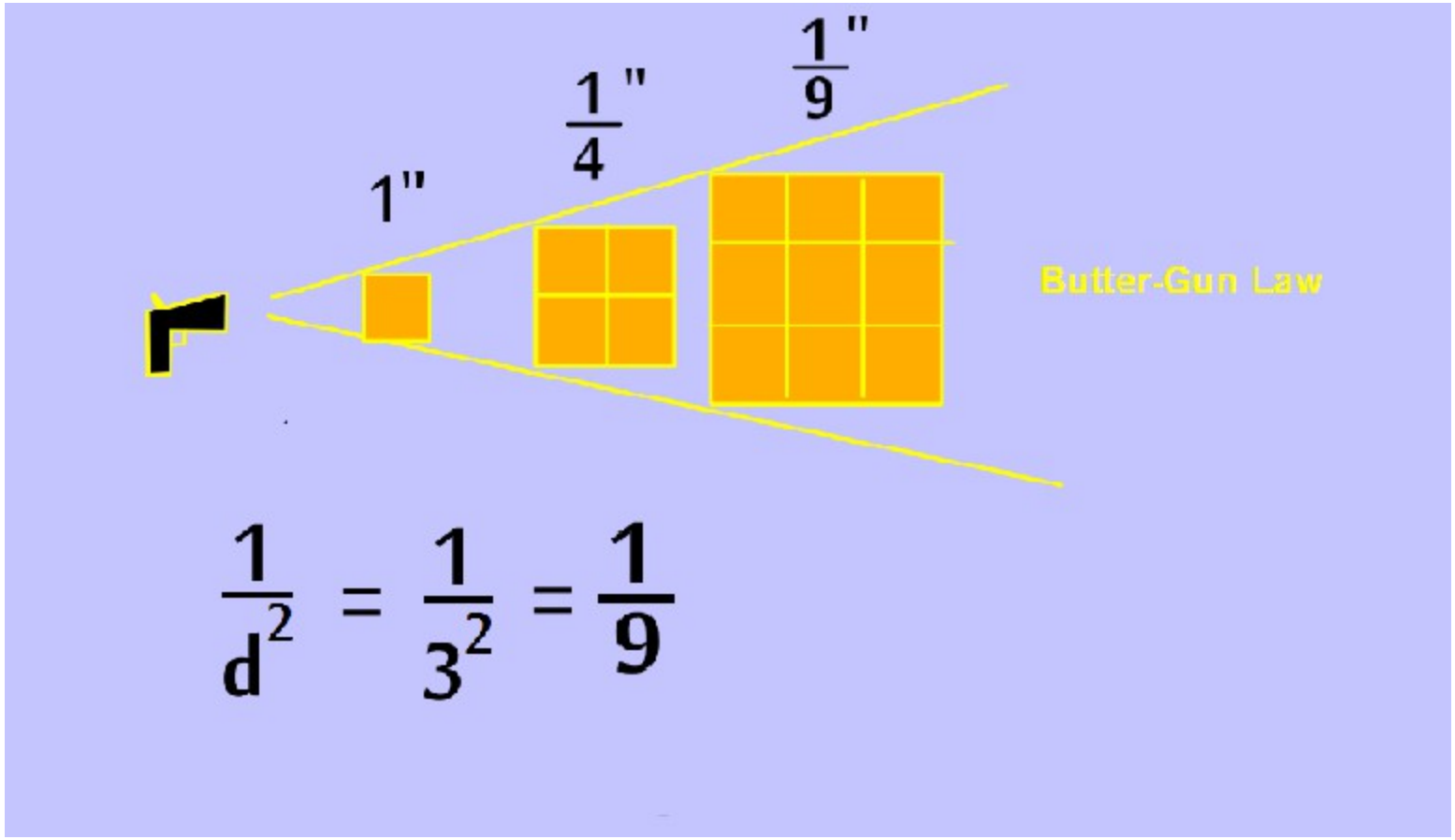
Gravitation

THE Butter Gun


1"
1/4"
1/9"
Butter-Gun Law
d
2d
3d
Inverse Square Law
Butter ∝ 1/d²


1"
1/4"
1/9"
Butter-Gun Law
1/d^2 = 1/1^2 = 1/1 = 1"


1"
1/4"
1/9"
Butter-Gun Law
1/d² = 1/2² = 1/4"


1"
1/4"
1/9"
Butter-Gun Law
1/d^2 = 1/3^2 = 1/9

PROBLEMS

Two types:

- Calculation
- Inverse Square Problems

EXAMPLE PROBLEM

$$F = \frac{G\, m_1\, m_2}{d^2}$$

What is the gravitational attraction between a 4 kg baby and the planet Mars?

Mass of Mars = 6.4191×10^{23} kg

Closest Distance from Earth to Mars 5.6×10^{10} m

$$F_g = \frac{(6.67 \times 10^{-11})\,(4)\,(6.4191 \times 10^{23})}{(5.6 \times 10^{10})^2}$$

$$F_g = 5.46 \times 10^{-8}\ \text{N}$$

EXAMPLE PROBLEM

$$F = \frac{G\, m_1\, m_2}{d^2}$$

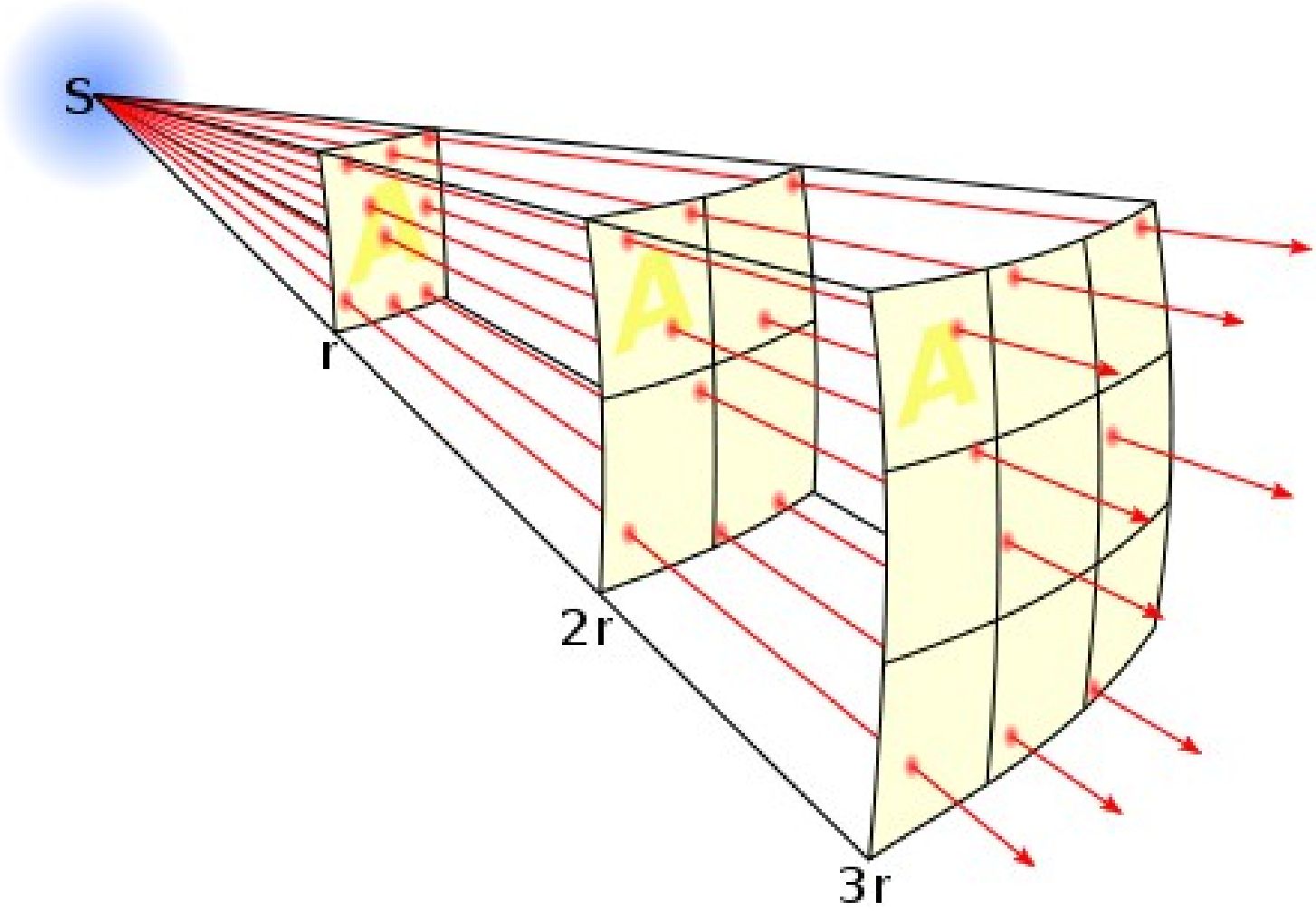
If you double the distance between two objects, and double the mass of one of the objects, what happens to the force of gravity between them?

BEFORE

$$\frac{(1)(1)}{(1)^2} = 1$$

AFTER

$$\frac{(2)(1)}{(2)^2} = \frac{2}{4} = \frac{1}{2}$$


S
A
A
A
r
2r
3r