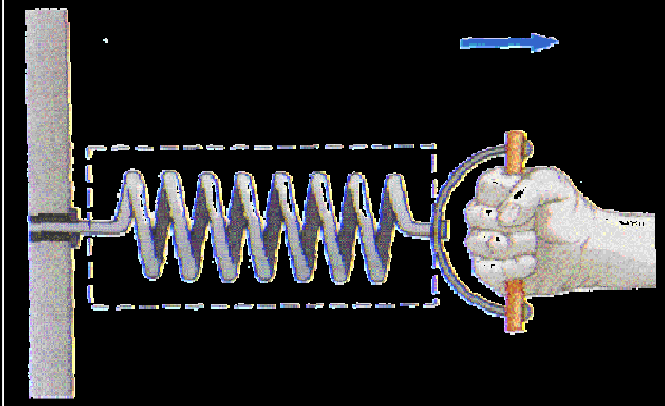
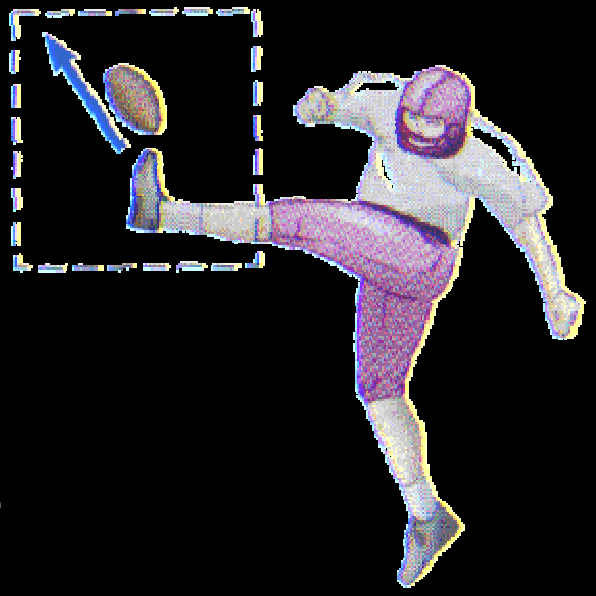




Forces

A quick review of what we know and then some more…

Four fundamental forces

- Gravitational, (long range, attractive, unidirectional)
- Electromagnetic (works both ways)
- Strong nuclear (holds protons and neutrons together)
- Weak nuclear (occurs in some radioactivity)

Examples of forces

- Contact forces (push, pull, friction)
- Long range forces (electromagnetic, gravitational)

Gravity

- Force of gravity = weight.
- Mass = amount of matter.
- We say g = 9.80 m/s^2 but it can also be 9.80 N/kg.
- If my monkey has a mass of 5.50 kg what is his weight?

$$w = mg$$

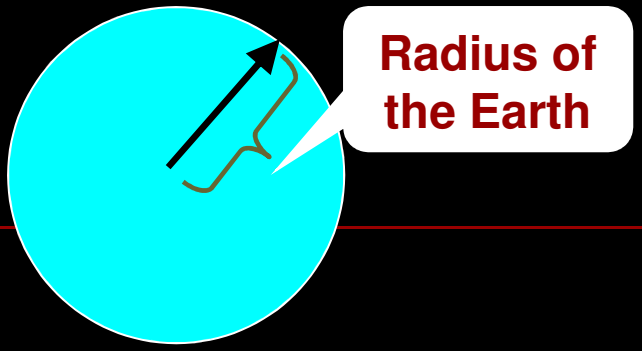
$$w = (5.50kg) \bullet (9.80\ {}^{N}\!/_{kg})$$

$$w = 53.9N$$

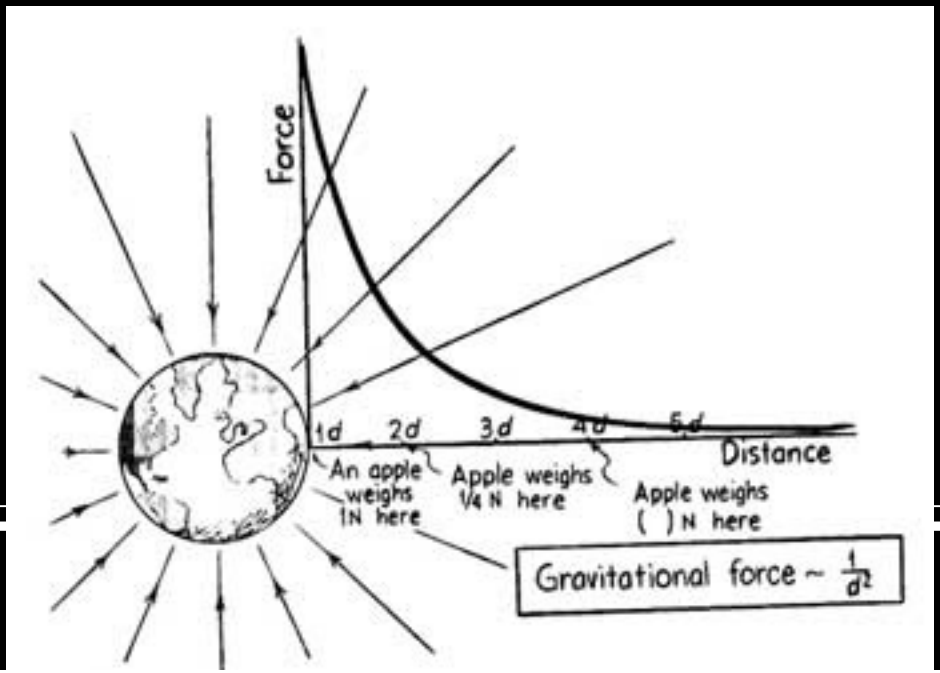
Is g a constant?

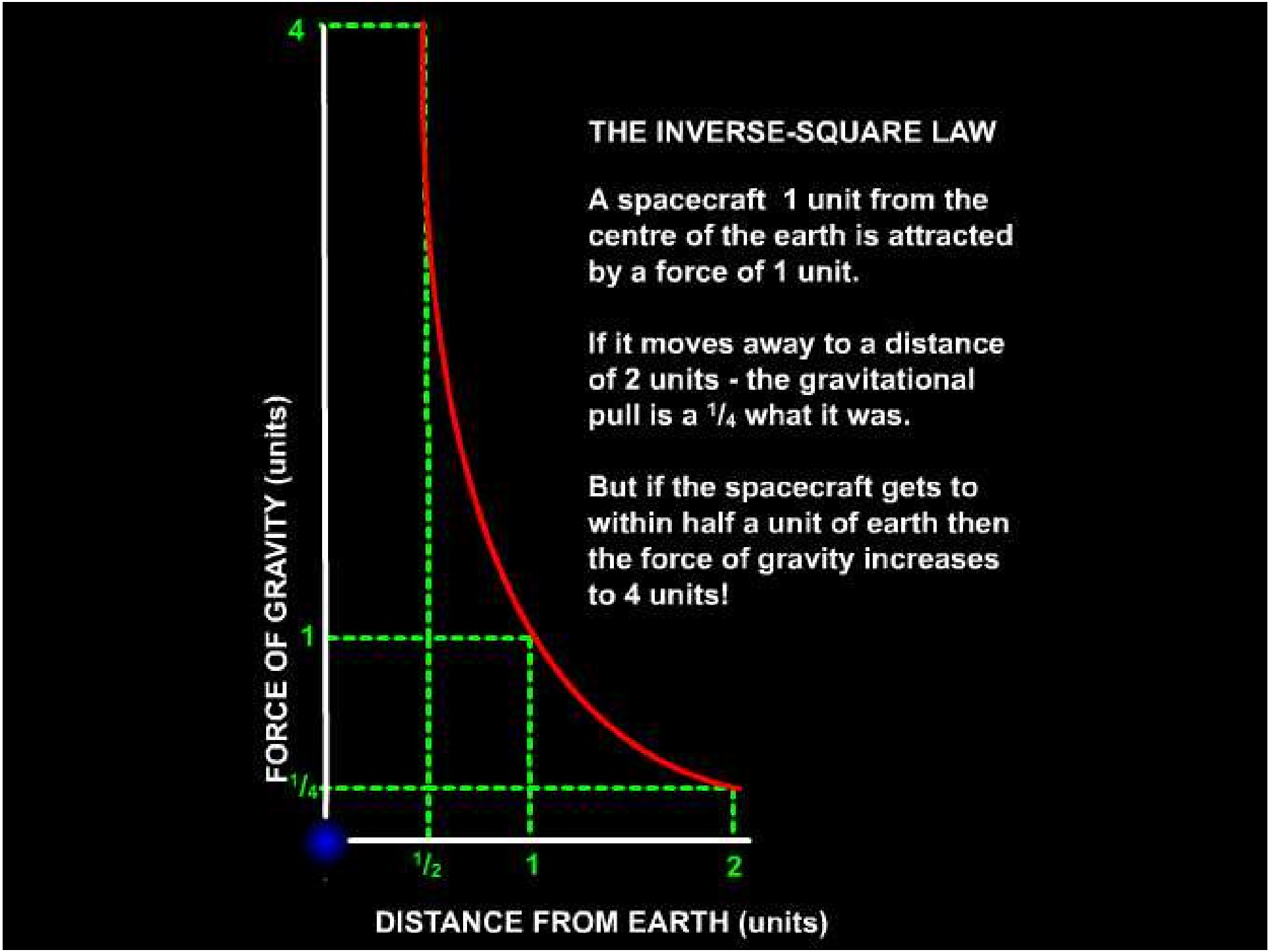
- No!!
- Where does it change and why?
- What about the Moon? (g = 1.6N/kg)
- What is the inverse squared relationship and when do we need to consider its effect?
- What would happen to the w of the monkey if I doubled and then tripled its distance from earth?

monkey continued



- If R is doubled then w is quatered.
- So if R is tripled then w is _____ of its value.

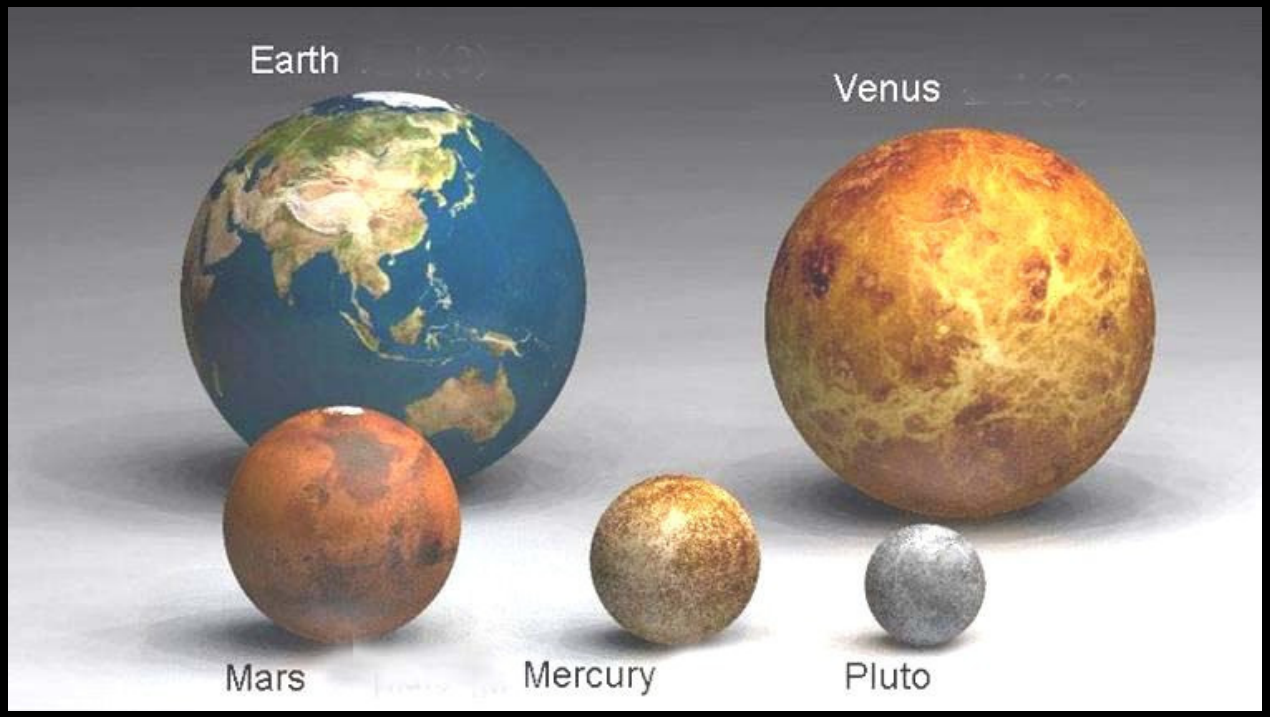



THE INVERSE-SQUARE LAW
A spacecraft 1 unit from the centre of the earth is attracted by a force of 1 unit.
If it moves away to a distance of 2 units - the gravitational pull is a 1/4 what it was.
But if the spacecraft gets to within half a unit of earth then the force of gravity increases to 4 units!
FORCE OF GRAVITY (units)
4
1
1/4
1/2
1
2
DISTANCE FROM EARTH (units)

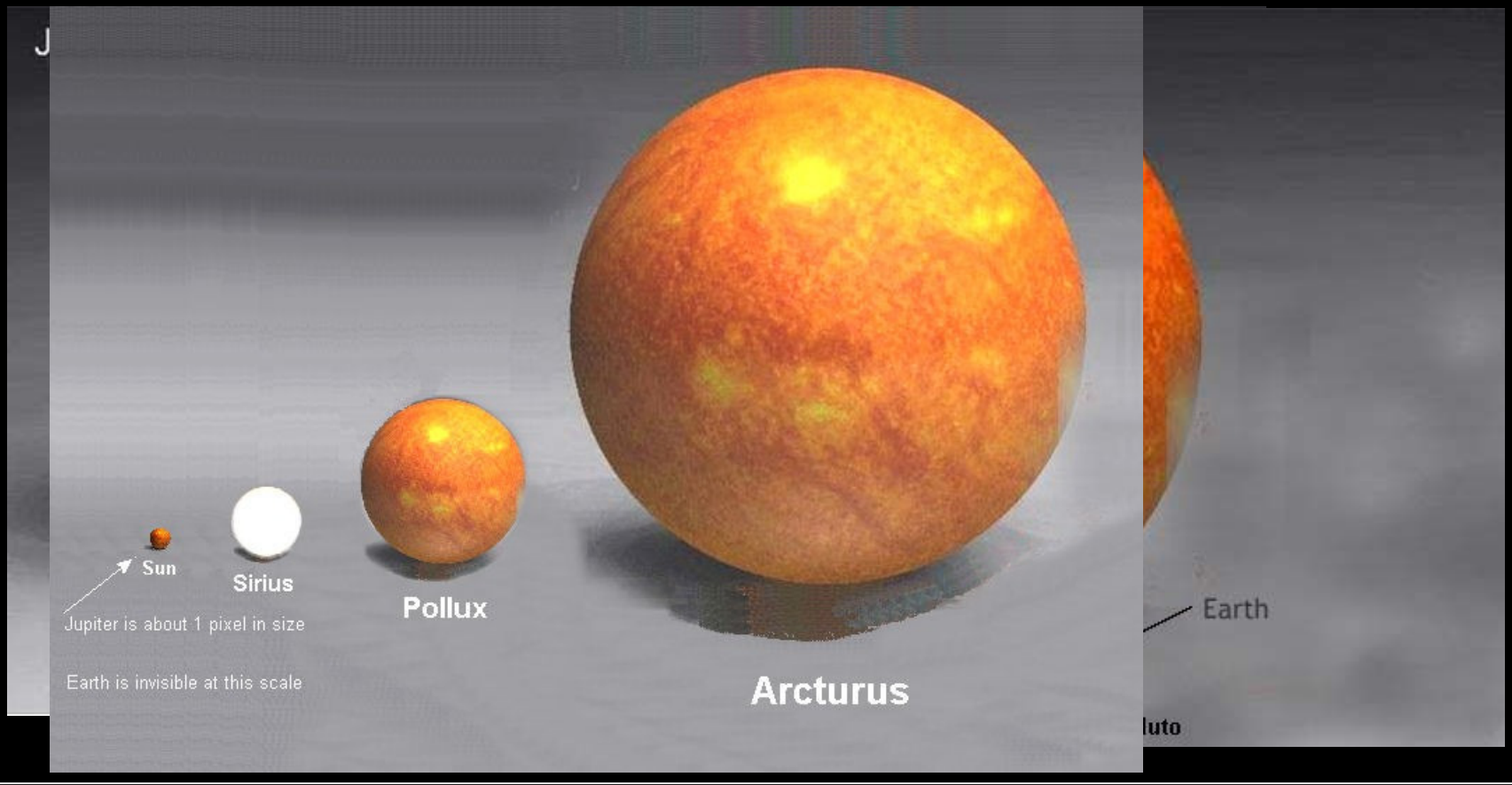
Where does Gravity come from?

- Always the centre of the Earth, Moon, …
- What determines how much force of gravity objects will exert on one another?
  - Mass (direct relationship)
  - Distance. (inverse squared relationship)

g = 9.80N/kg on Earth



A sense of scale...



Universal Law of Gravitation

Newton's law of universal gravitation states that any two objects of masses m_1 and m_2 separated by a distance r will exert a gravitational force on each other. This gravitational force is an attractive force and is directly proportional to the product of the masses ($F = m_1m_2$) and inversely proportional to r^2 ($F = 1/r^2$).

Universal Law of Gravitation

$$F_{grav} = \frac{Gm_1m_2}{R^2}$$

G = Universal Gravitational Constant

$G = 6.673 \times 10^{-11}\ N.m^2/kg^2$

What is the F_{grav} on a 6.00 kg monkey here on the Earths surface?

$$W = mg$$

$$w = (6.00kg)(9.80\ {}^{N}\!/_{kg})$$

$$w = 58.8N$$

$$F_{grav} = \frac{G.m_1.m_2}{R^2}$$

$$F = \left(6.67x10^{-11}\ {}^{Nm^2}\!/_{kg^2}\right)\left(\frac{6.00kg \times 5.97 \times 10^{24}\,kg}{(6.38 \times 10^{6}\,m)^2}\right)$$

$$F = 58.7N$$

4 U 2 Try

- Page 110, Practice Questions
- Also Page 124 do questions # 18, 19, 20, 21, 22.