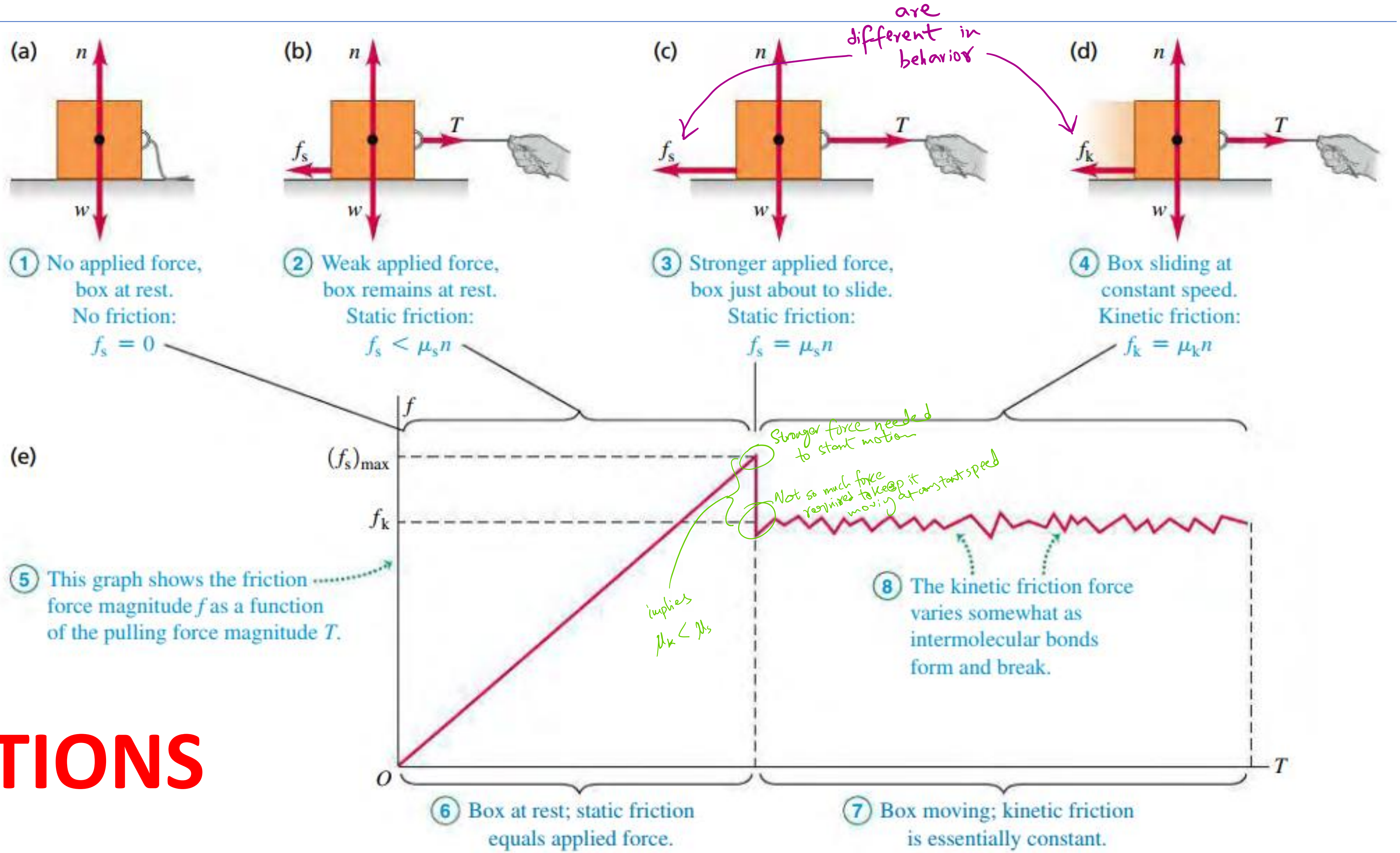
Our knowledge of nature of force of friction comes from experiments.



FRICTIONS

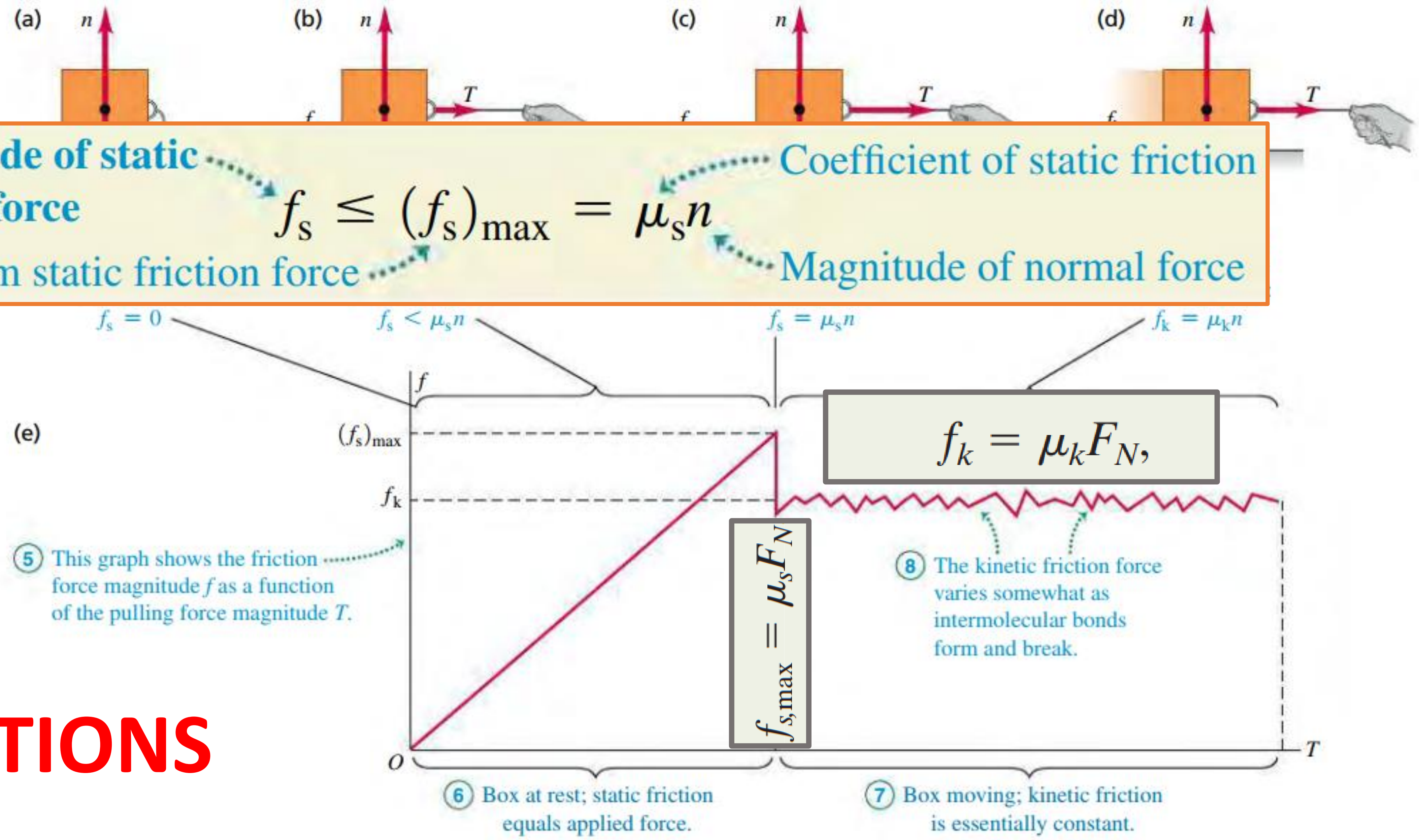
Magnitude of static friction force

Maximum static friction force

$$f_s \le (f_s)_{max} = \mu_s n$$

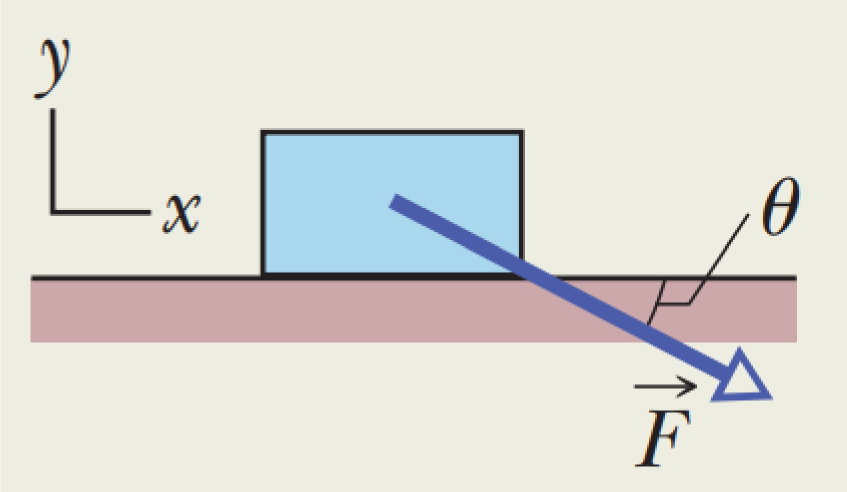
Coefficient of static friction

Magnitude of normal force



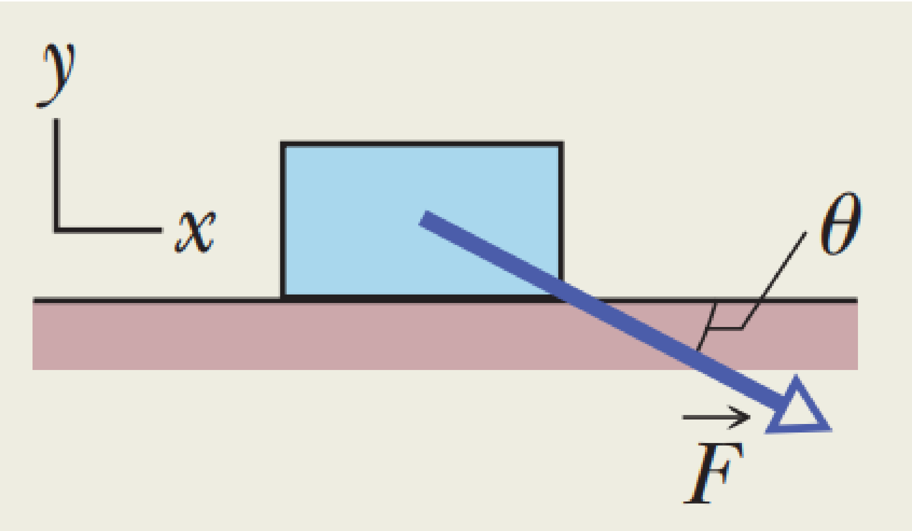
FRICTIONS

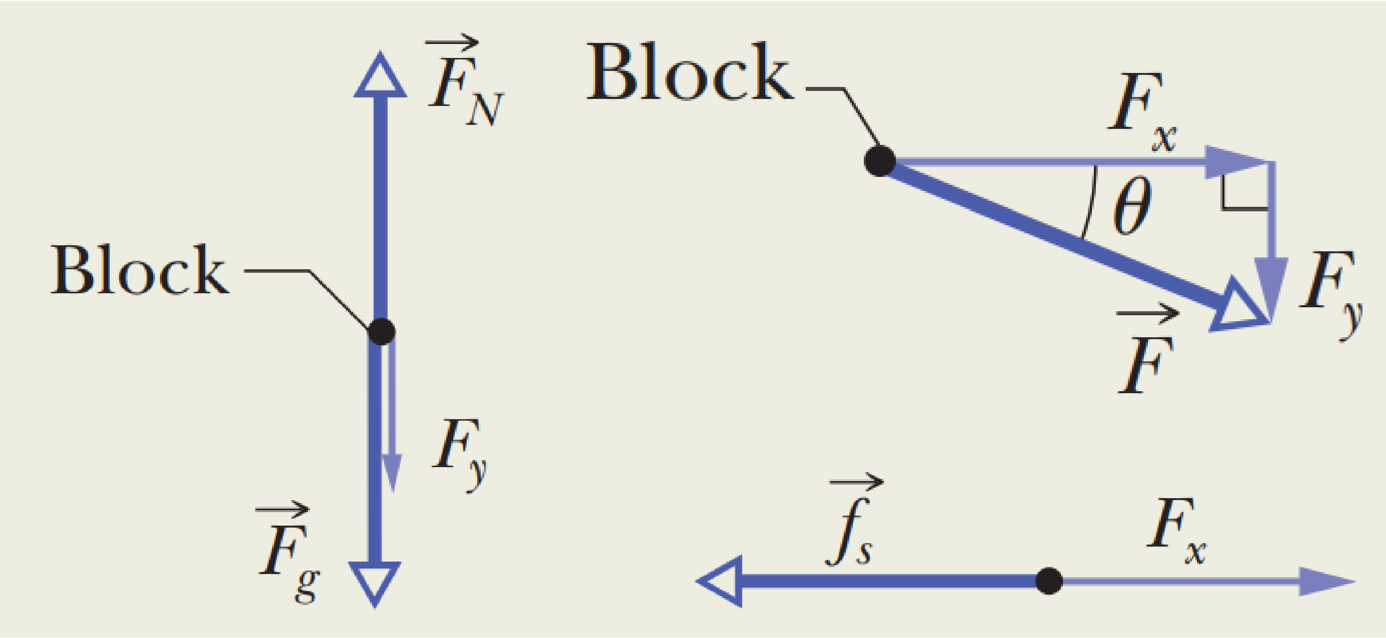
12.0 N applied to an 8.00 kg block at a downward angle of $\theta = 30.0°$. The coefficient of static friction between block and floor is $\mu_s = 0.700$; the coefficient of kinetic friction is $\mu_k = 0.400$. Does the block begin to slide or does it remain stationary? What is the magnitude of the frictional force on the block?



point ont the condition you need to prove.

$$F_x \overset{?}{\geq} f_{s,max}$$





$$F_x = F\cos\theta$$
$$= (12.0\text{ N})\cos 30° = 10.39\text{ N.}$$

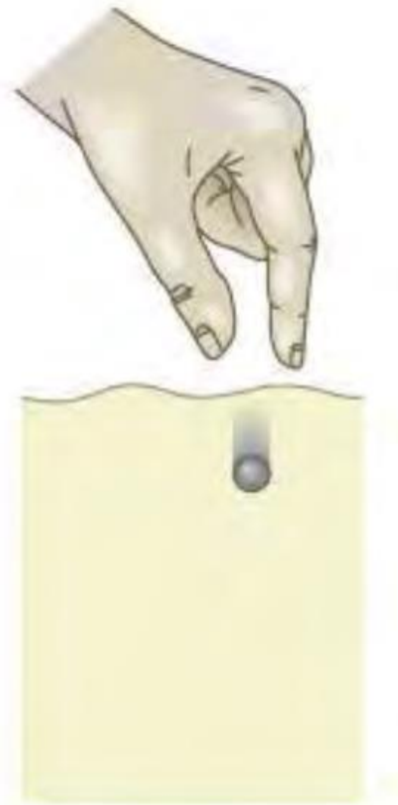
total vertical forces

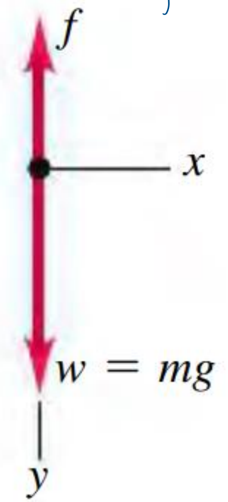
$$F_N - mg - F\sin\theta = m(0),$$

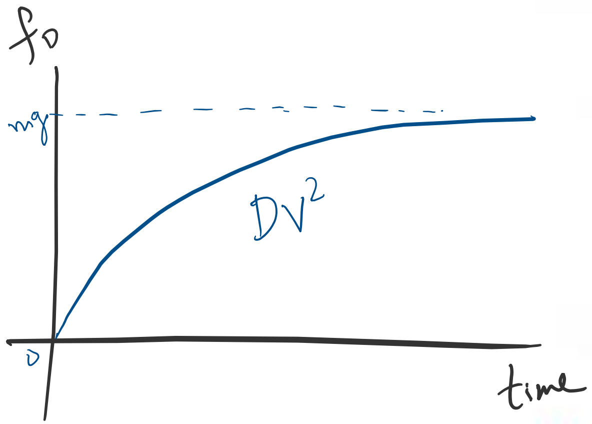
$$f_{s,\max} = \mu_s(mg + F\sin\theta)$$
$$= (0.700)((8.00\text{ kg})(9.8\text{ m/s}^2) + (12.0\text{ N})(\sin 30°))$$
$$= 59.08\text{ N.} \quad (6$$

Fluid Resistance:

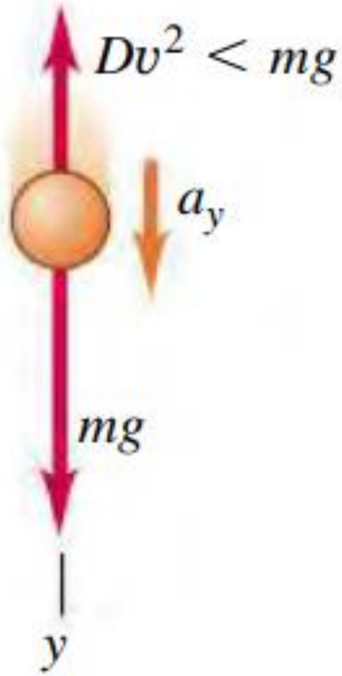
occurs when fluid particles consecutively strike the solid object and resist motion.



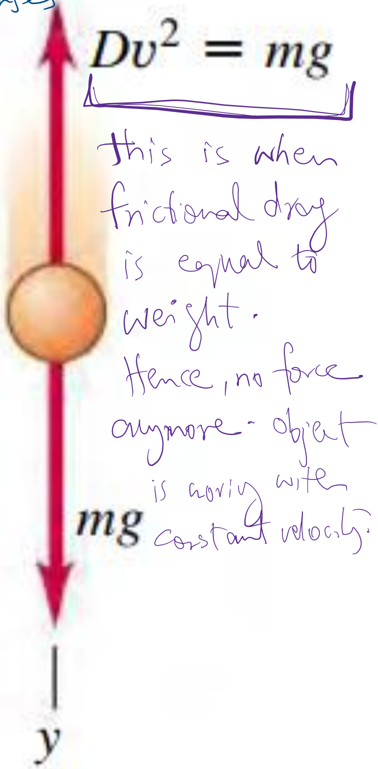




As the object accelerates the velocity increases, therefore frictional drag also increases.



Before terminal speed: Object accelerating, drag force less than weight.

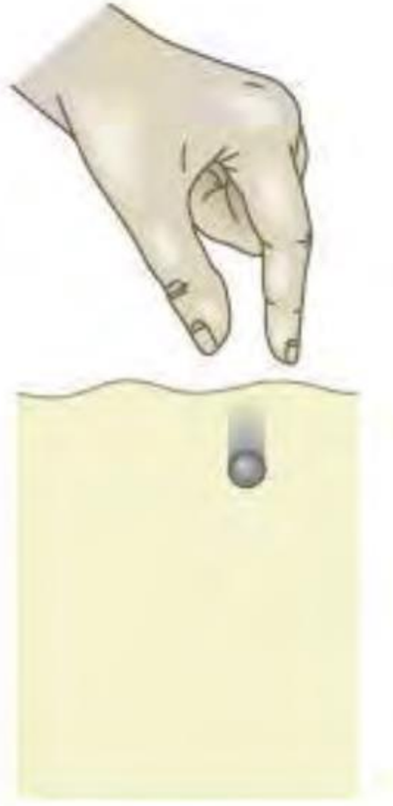


This is when frictional drag is equal to weight. Hence, no force anymore. object is moving with constant velocity.

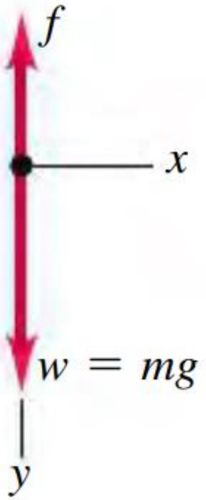
At terminal speed v_t: Object in equilibrium, drag force equals weight.

$$f = kv \qquad \text{(fluid resistance at low speed)}$$

$$f = Dv^2 \qquad \text{(fluid resistance at high speed)}$$



$$\sum F_y = mg + (-kv_y) = ma_y$$

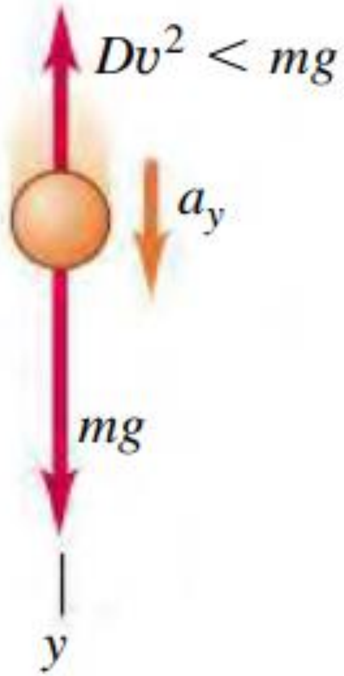


$$\boxed{v_t = \frac{mg}{k}}$$

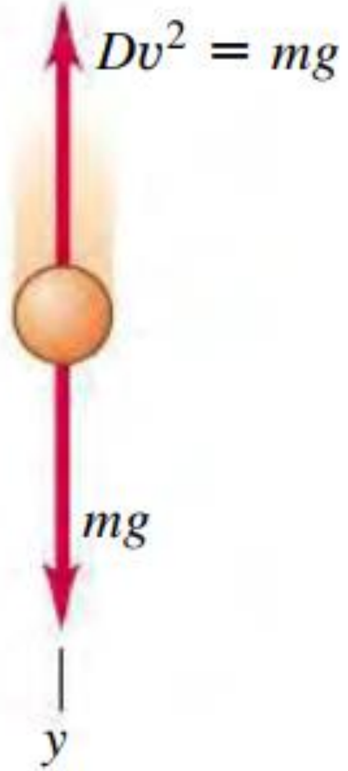
Terminal velocity
at low speeds

$$f = kv \qquad \text{(fluid resistance at low speed)}$$

$$f = Dv^2 \qquad \text{(fluid resistance at high speed)}$$



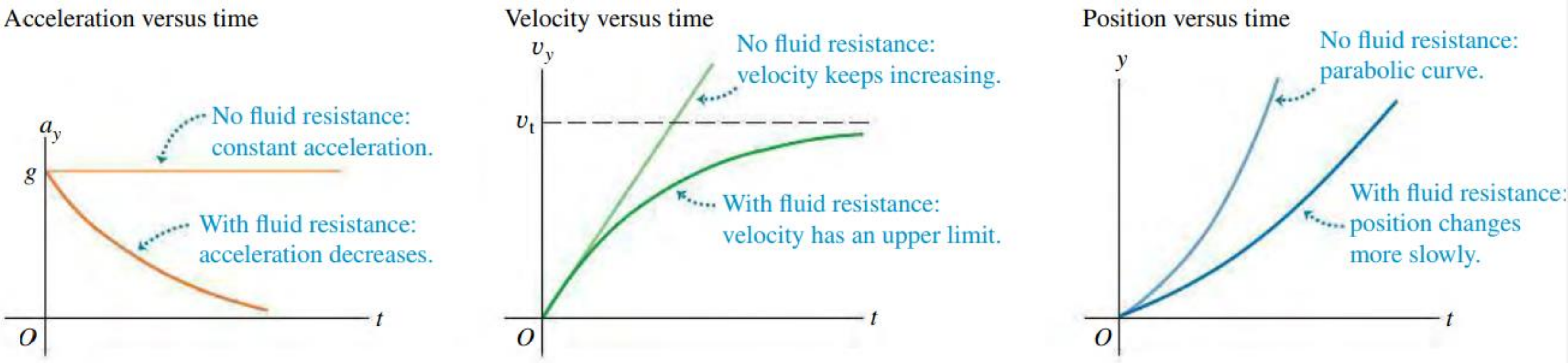
Before terminal speed: Object accelerating, drag force less than weight.



At terminal speed v_t: Object in equilibrium, drag force equals weight.

Lecture 11

ignoring the friction gave us a very neat but unreal picture of motion.



Here, you'll see how acceleration, velocity and displacement change under fluid resistance

centripital acceleration is the resulting acceleration

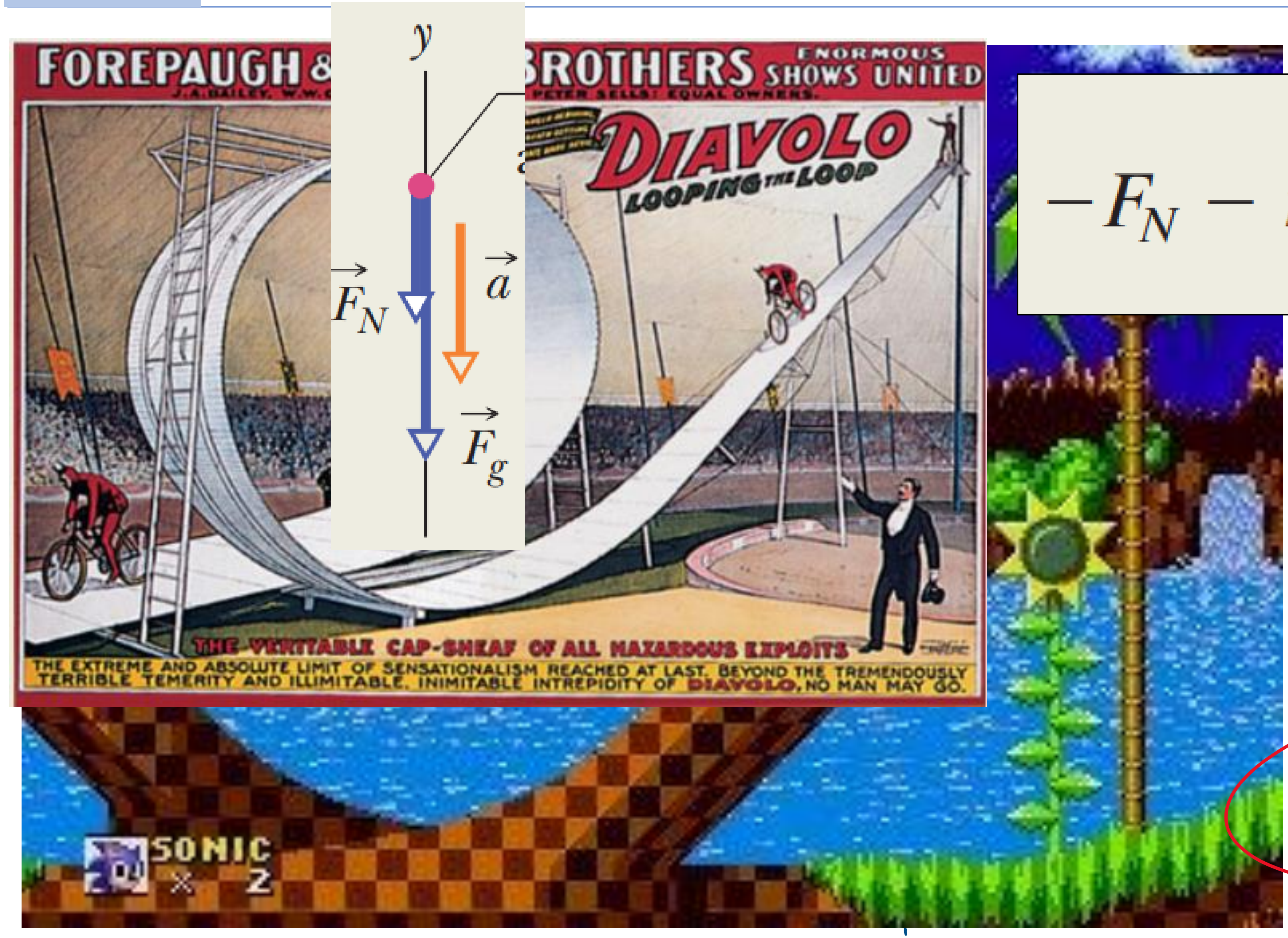
$$-F_N - mg = m\left(-\frac{v^2}{R}\right).$$

$\{F_N = 0\}$ just about to loose the surface contact

Minimum velocity to make this path

$$\boxed{v = \sqrt{gR}}$$

more velocity than this will only make it easier for Sonic



$$-F_N - mg = m\left(-\frac{v^2}{R}\right).$$

Minimum velocity to make this path

$$\boxed{v = \sqrt{gR}}$$

independent of mass

Gravitational constant

Mass of the earth

Weight of a body at the earth's surface ...

$$w = F_g = \frac{G m_E m}{R_E^2}$$

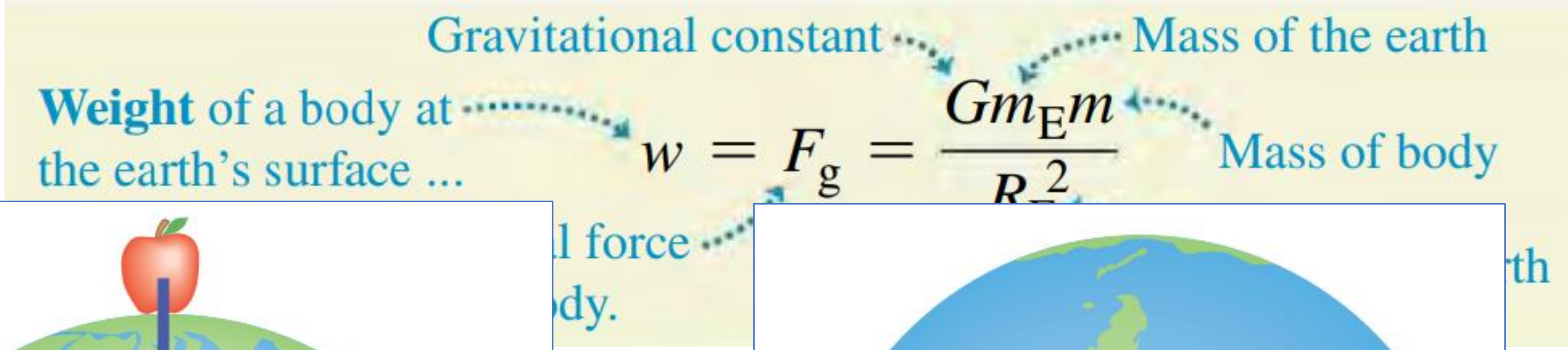
Mass of body

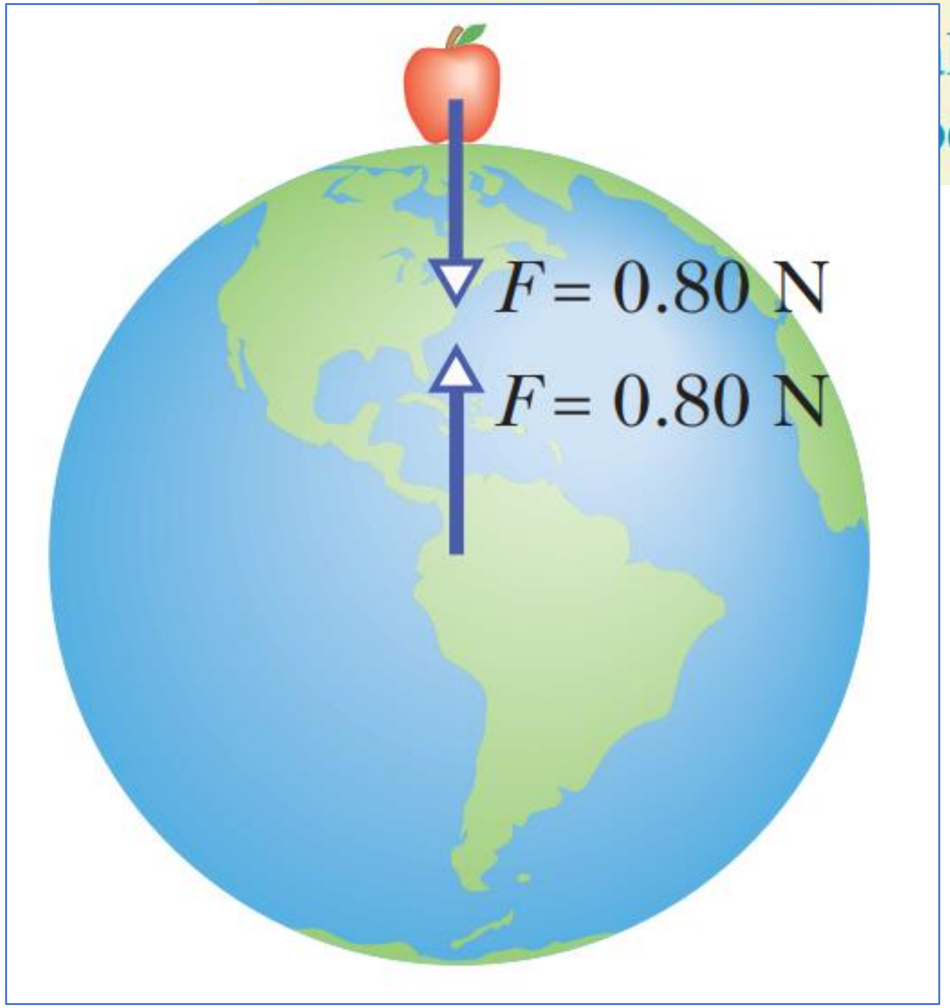
... equals gravitational force the earth exerts on body.

Radius of the earth

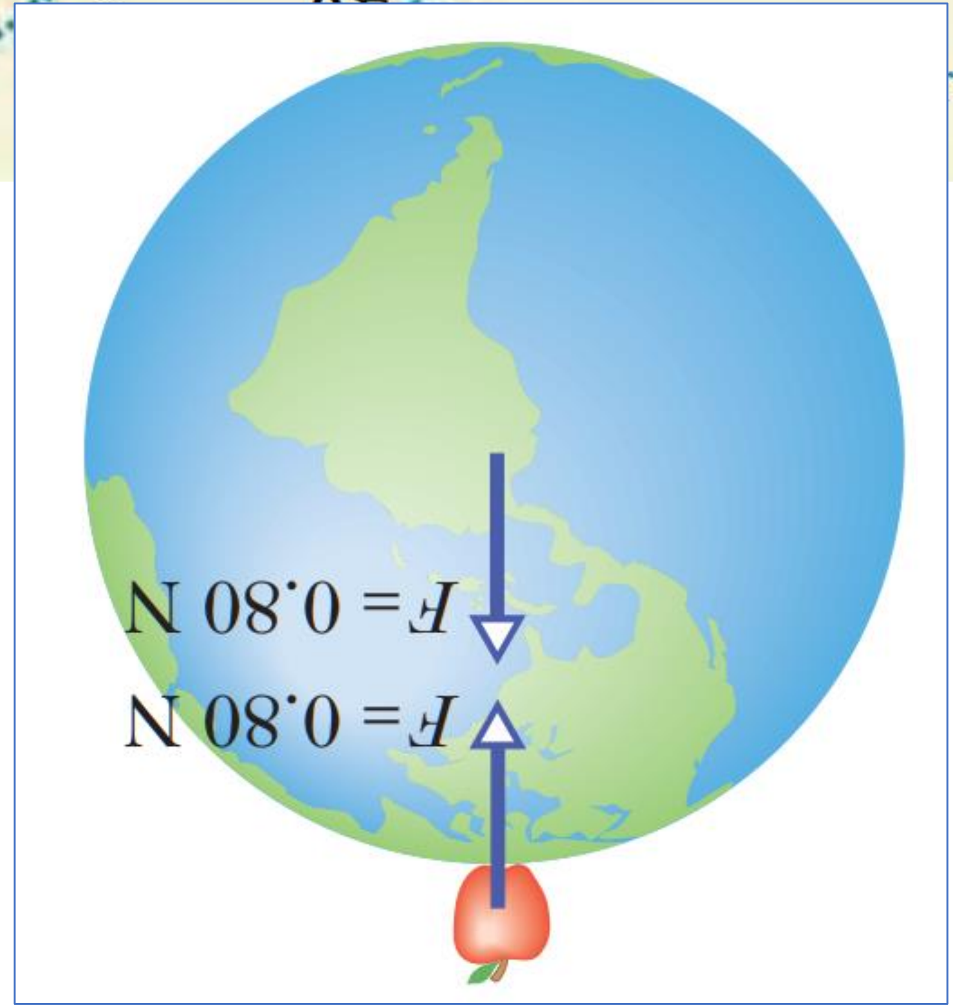
will equal to 'ma' when only gravitational force is considered.

design of actual gravitational force


Gravitational constant
Mass of the earth
Weight of a body at the earth's surface ...
$w = F_g = \frac{Gm_E m}{R_E^2}$
Mass of body


F = 0.80 N
F = 0.80 N

=

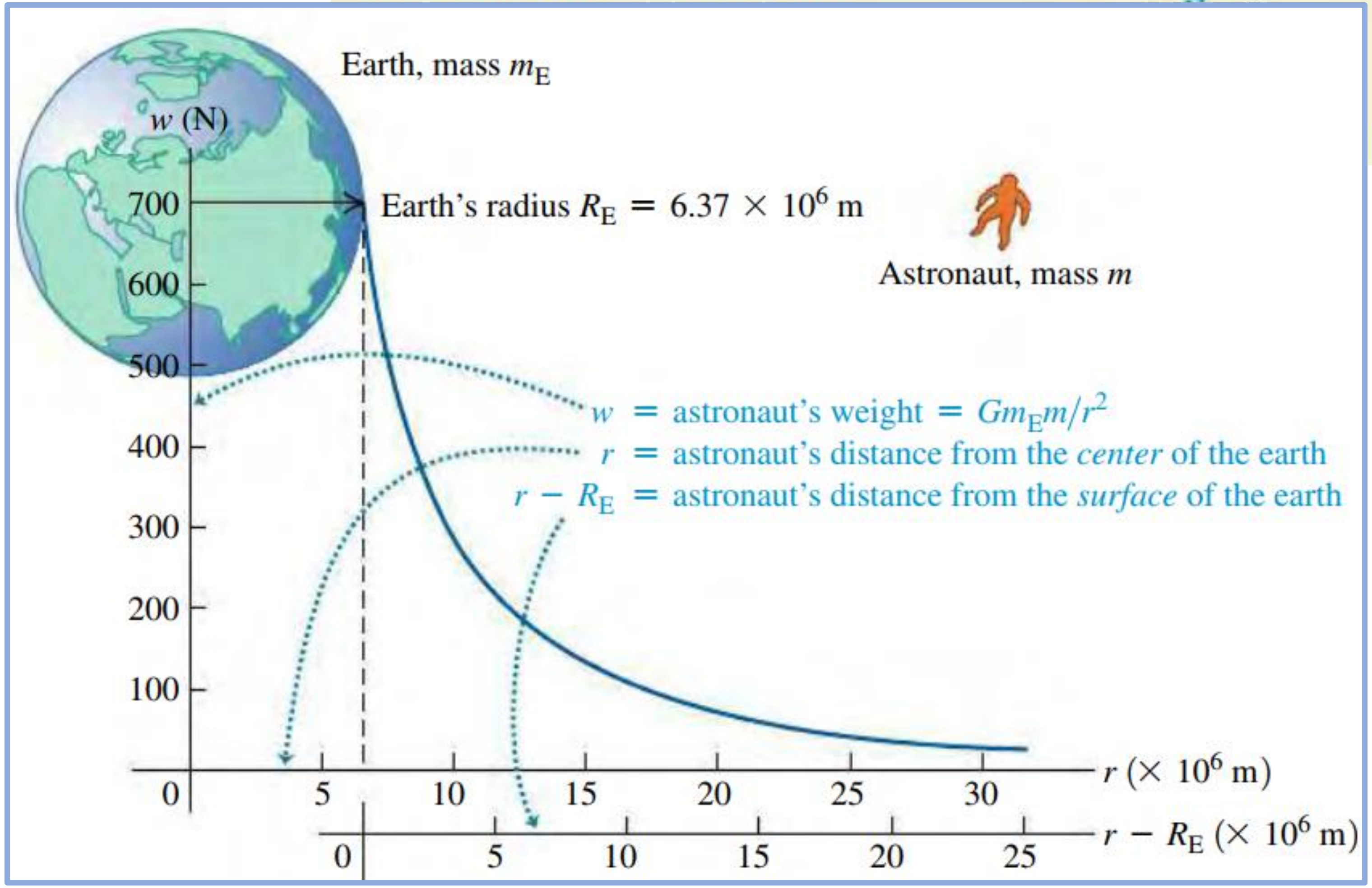

F = 0.80 N
F = 0.80 N

Gravitational constant — Mass of the earth

Weight of a body at the earth's surface ... $$w = F_g = \frac{Gm_E m}{R_E^2}$$

Mass of body

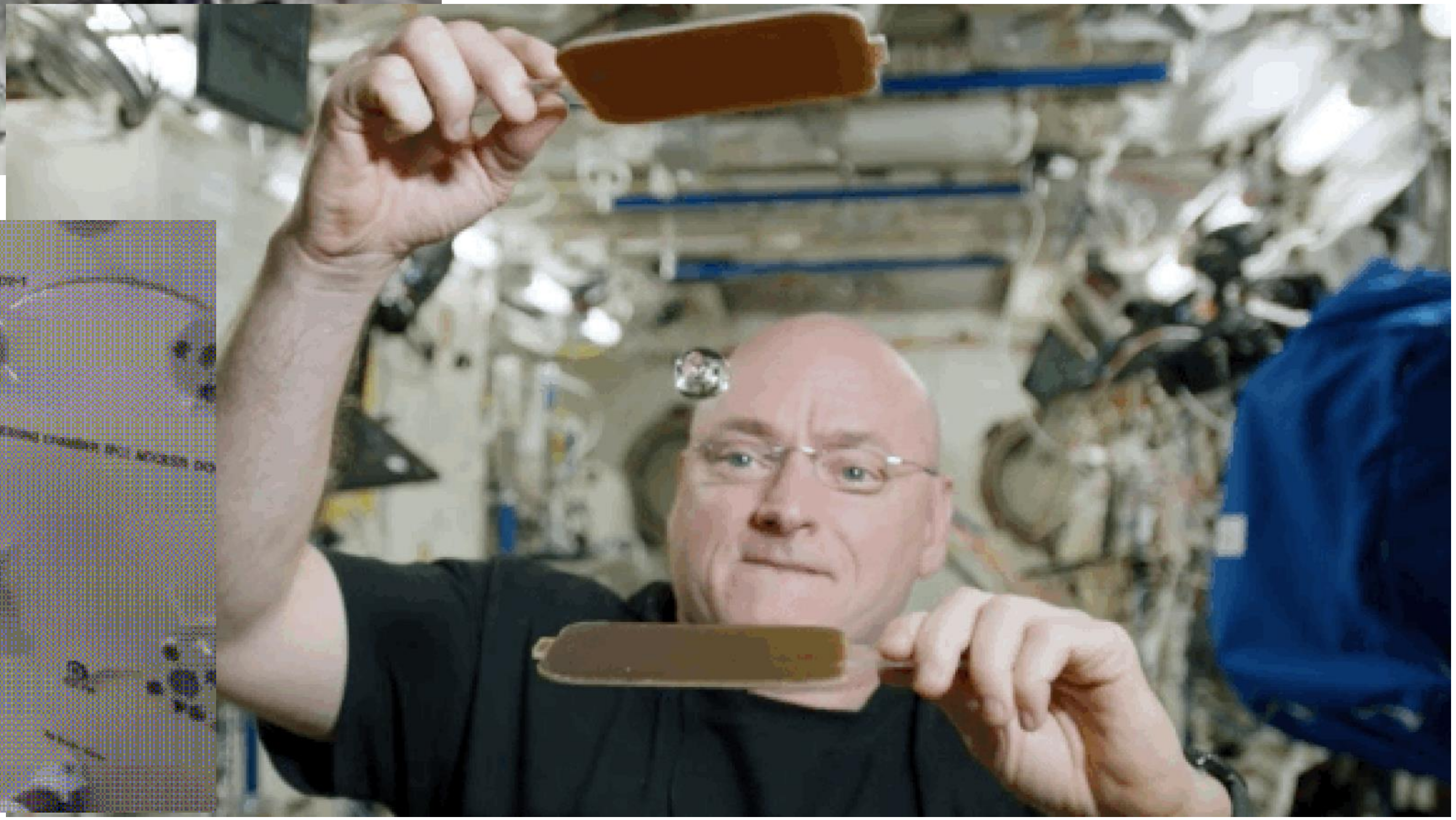
Radius of the earth

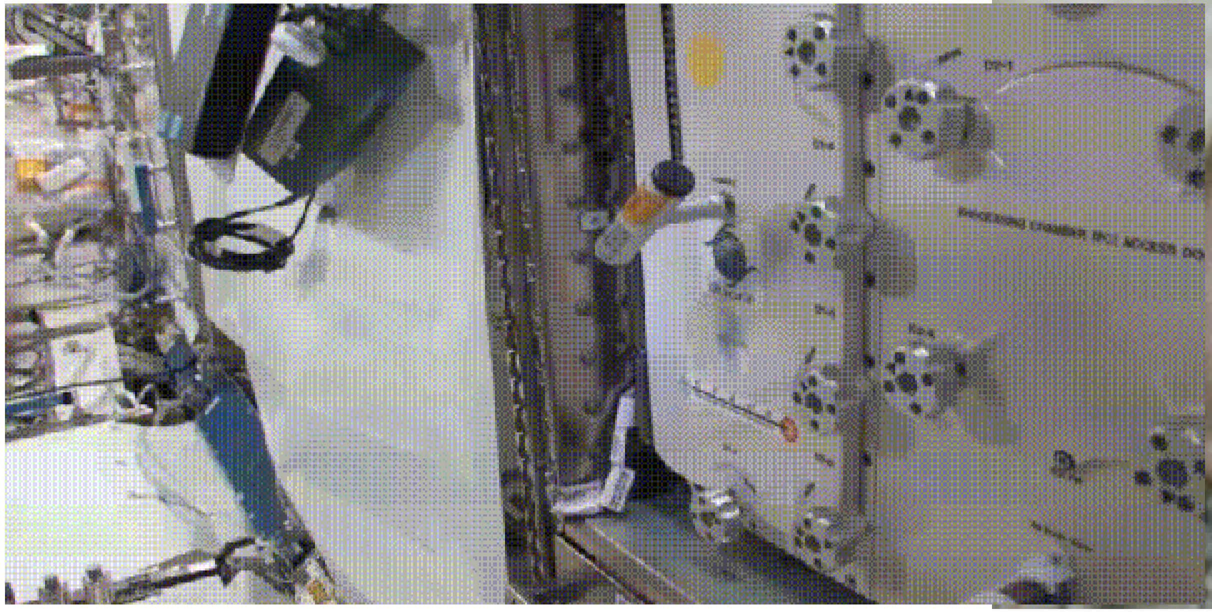


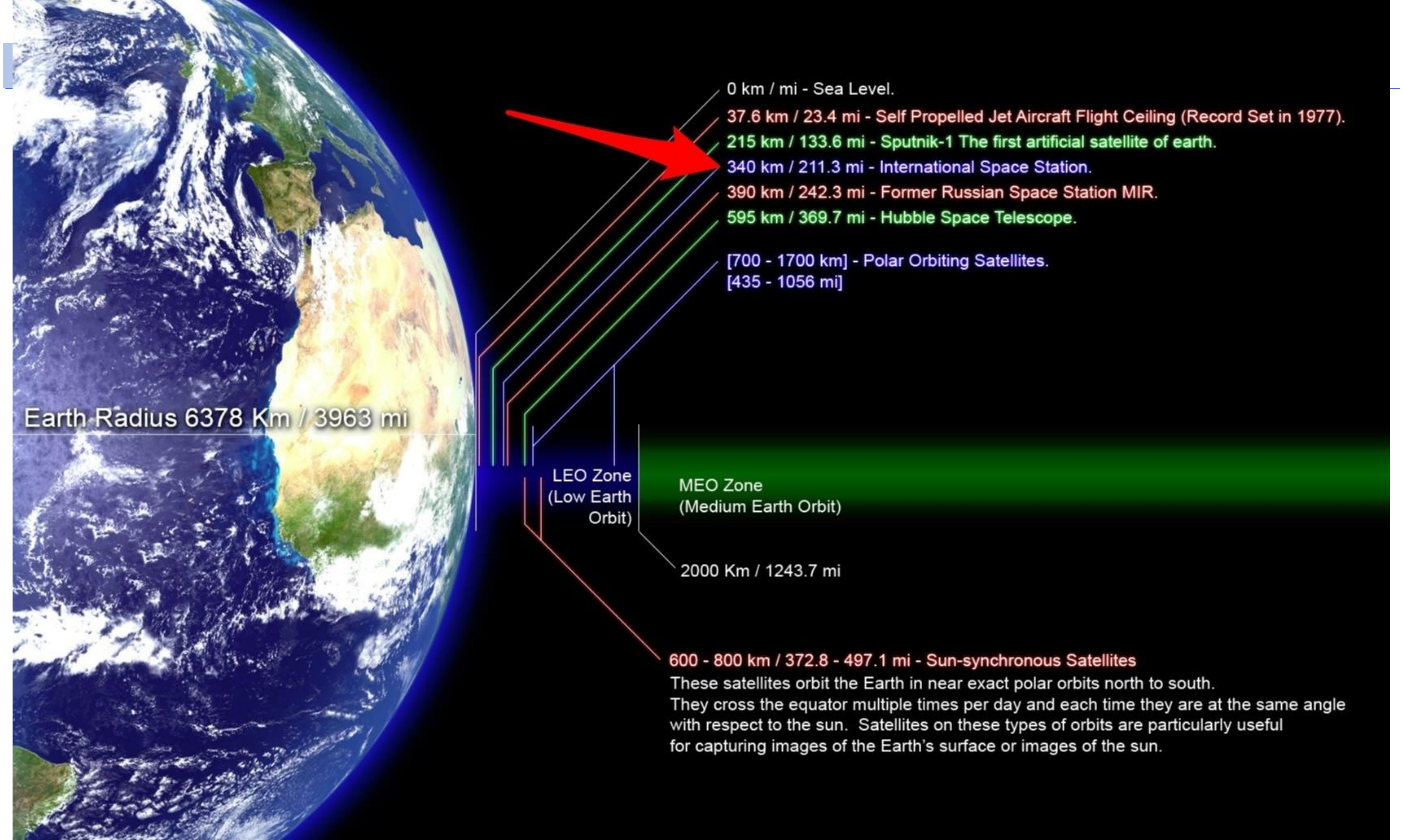
Curve shows how gravitational force decreases with distance

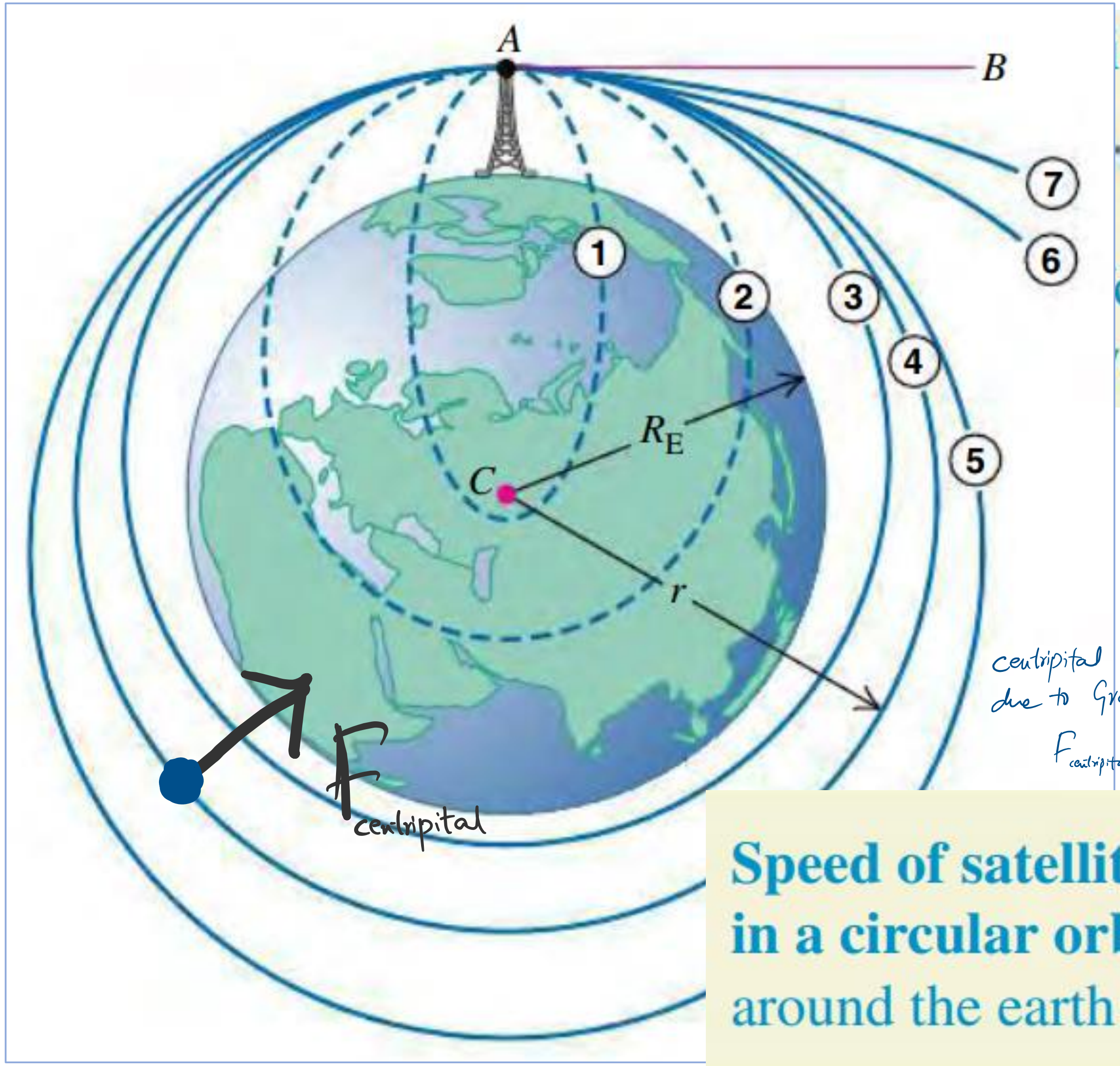
Lecture 1

Astronauts doing weird things in ISS (International Space Station)






0 km / mi - Sea Level.
37.6 km / 23.4 mi - Self Propelled Jet Aircraft Flight Ceiling (Record Set in 1977).
215 km / 133.6 mi - Sputnik-1 The first artificial satellite of earth.
340 km / 211.3 mi - International Space Station.
390 km / 242.3 mi - Former Russian Space Station MIR.
595 km / 369.7 mi - Hubble Space Telescope.
[700 - 1700 km] - Polar Orbiting Satellites.
[435 - 1056 mi]
Earth Radius 6378 Km / 3963 mi
LEO Zone
(Low Earth
Orbit)
MEO Zone
(Medium Earth Orbit)
2000 Km / 1243.7 mi
600 - 800 km / 372.8 - 497.1 mi - Sun-synchronous Satellites
These satellites orbit the Earth in near exact polar orbits north to south.
They cross the equator multiple times per day and each time they are at the same angle
with respect to the sun. Satellites on these types of orbits are particularly useful
for capturing images of the Earth's surface or images of the sun.



onal constant

Mass of the earth

$$w = F_g = \frac{G m_E m}{R_E^2}$$

Mass of body

orce

Radius of the earth

centripital acceleration is only due to Gravity

$$F_{centripital} = F_{gravity} \Rightarrow \frac{G m_e m}{r^2} = m\frac{v^2}{r}$$

Gravitational constant

Speed of satellite in a circular orbit around the earth

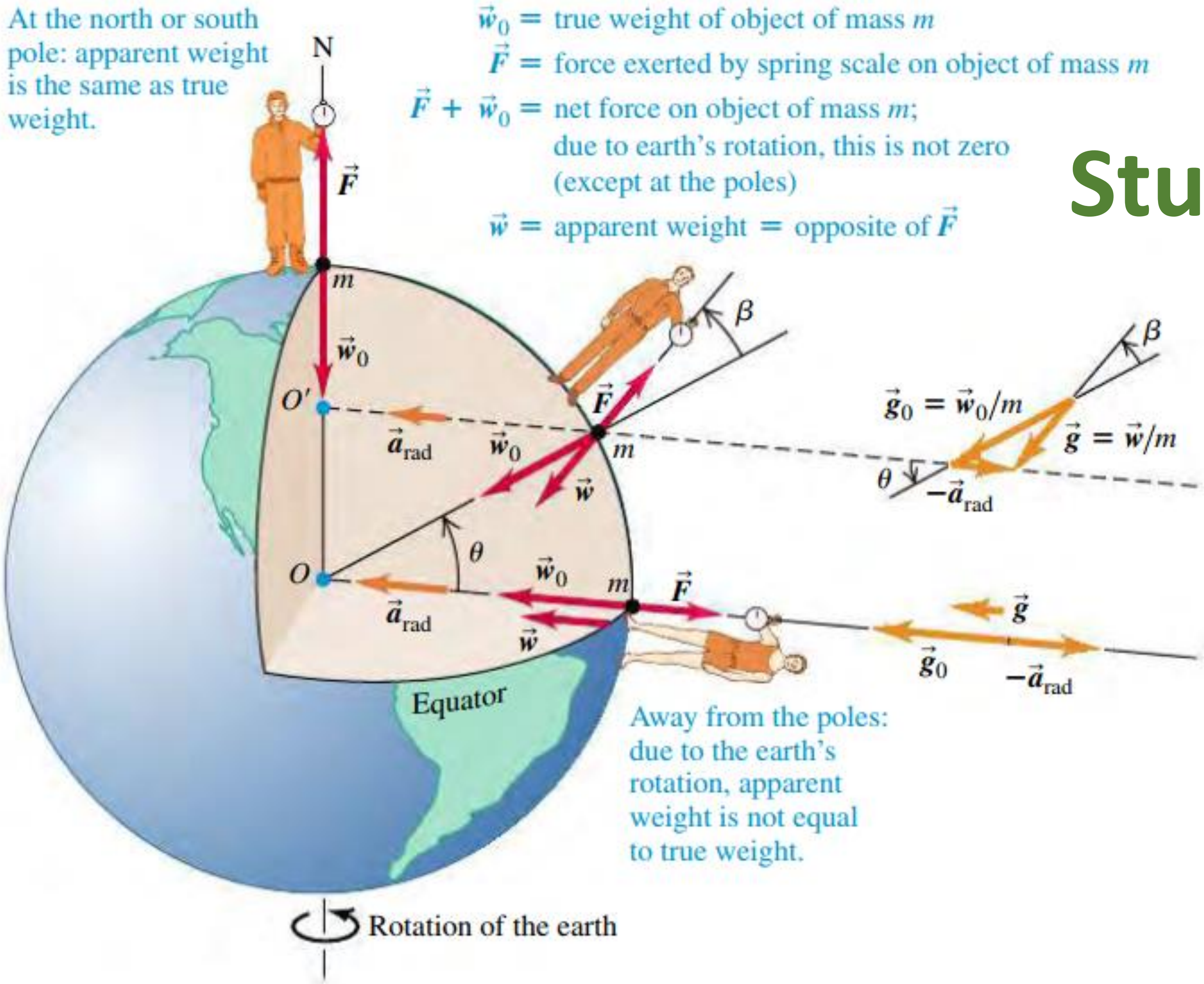
$$v = \sqrt{\frac{G m_E}{r}}$$

Mass of the earth

Radius of orbit

Study Challenge

Read the diagram and understand how a false weight vector arises on the surface of the earth.



Practice problems:

Problems from **Fundamentals of Physics**

-Jearl Walker

Chapter 6 : Forces and Motion II

Page#114

Problems: 6,8,12,19,27,42,57

sample prob:5.06, **6.02**

Additional Problems