미시세계와 거시세계

3. 뉴튼의 사과
“힘과 운동”

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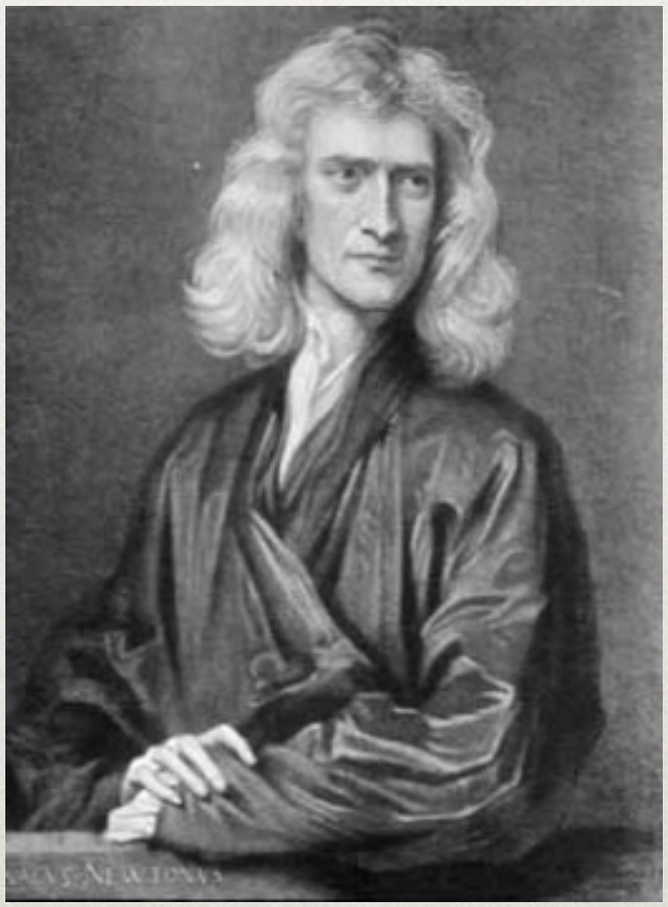
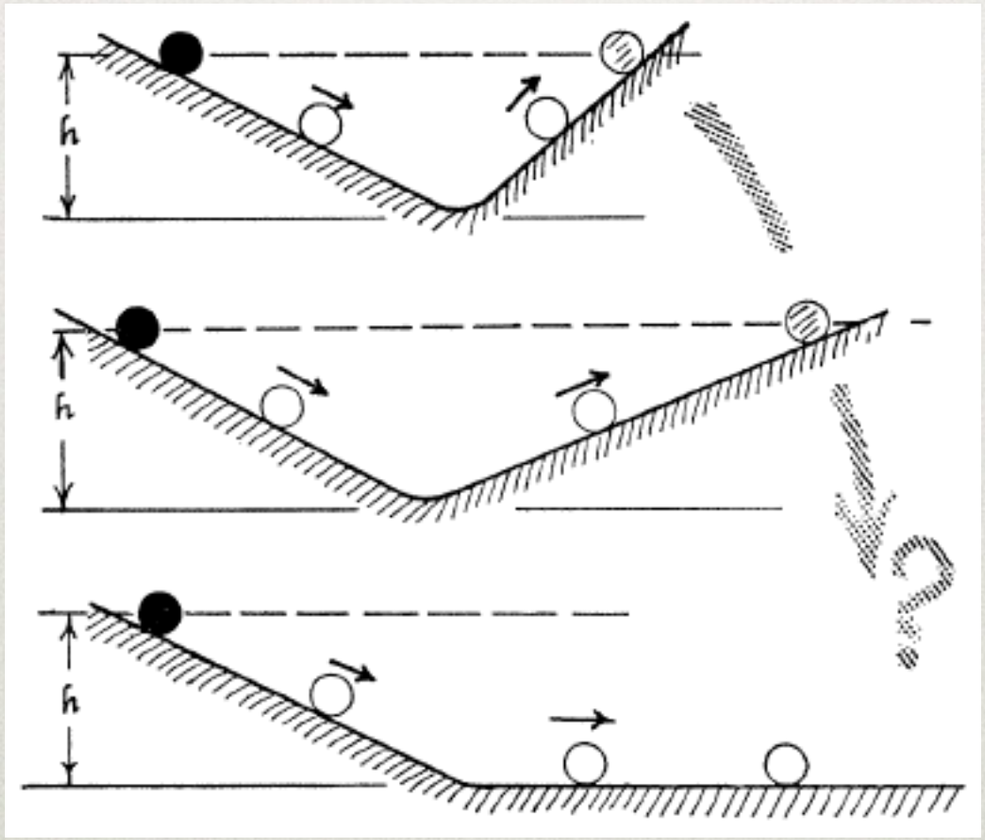
뉴튼



“If I have seen further it is by standing on the shoulders of giants.”

관성의 법칙

How do we know that the law of inertia works?



http://www.ifa.hawaii.edu/~barnes/ast110_06/rots/pftim19_02b.png

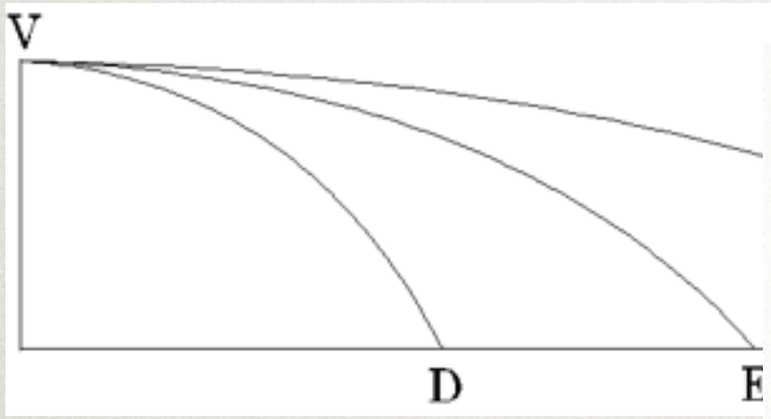
The Law of Inertia

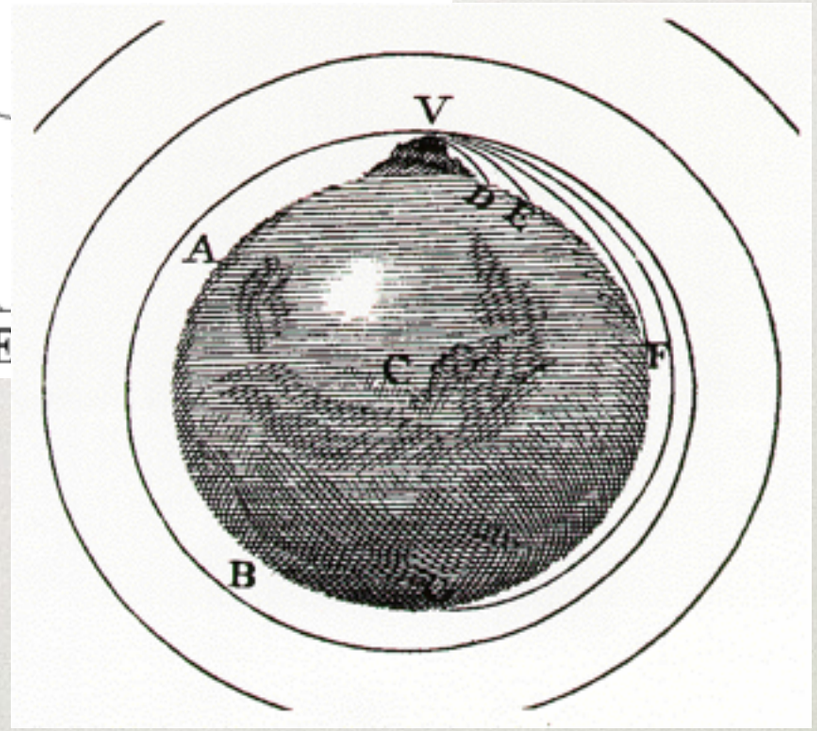
If no external influences act on a moving object,
then it will move in a straight line (at a constant velocity) forever.

"Why things move as they do?"

뉴튼의 정원: “사과”와 “달”

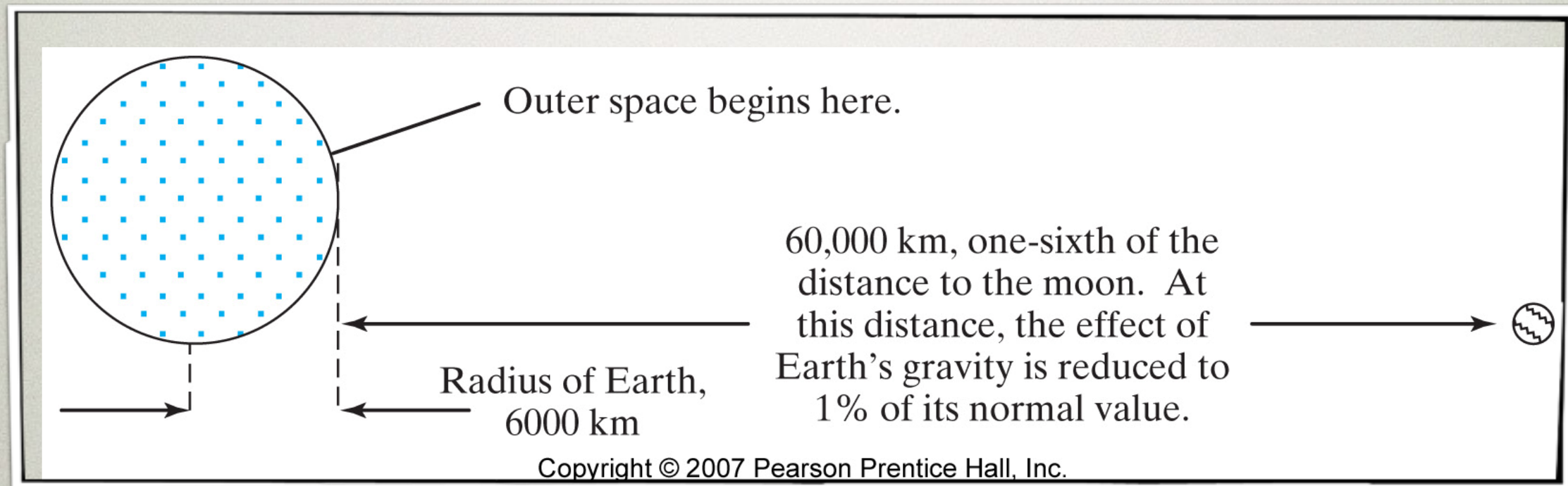
사과 멀리 날리기



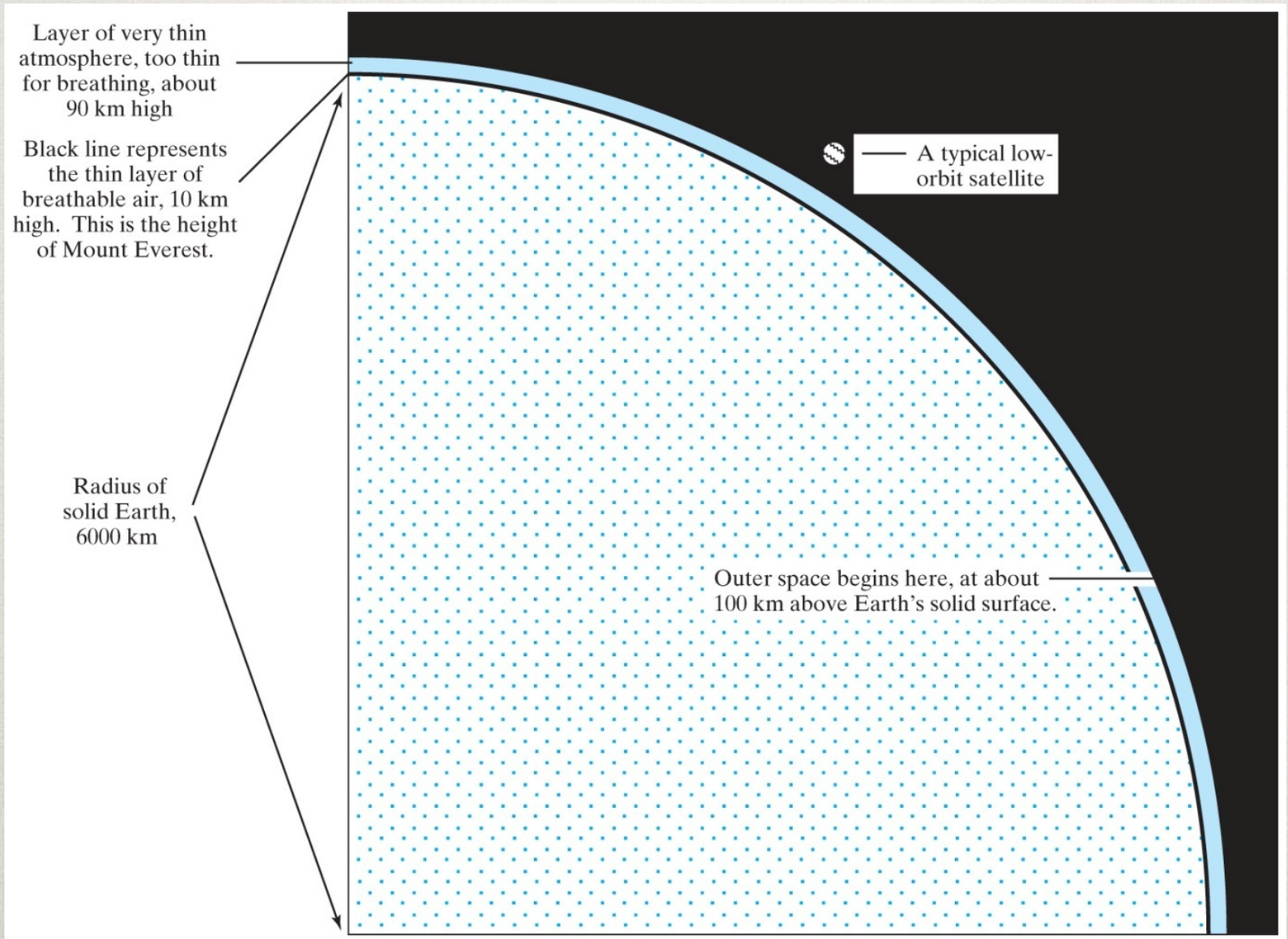


http://galileoandeinstein.physics.virginia.edu/more_stuff/Applets/newt/newtmtn.html

"무중력 상태 (?)"



우주 공간은 얼마나 멀리 있는가?



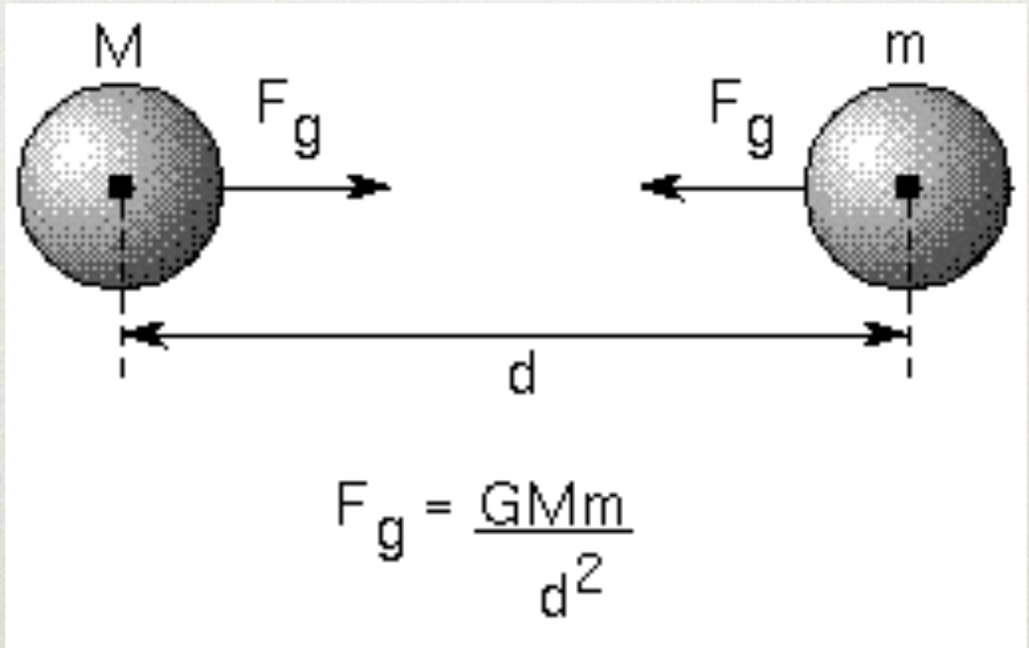
왜 물체는 가속을 하는가?

- **“force” = “external influence”**
  (What does “influence” mean?)
- **“force”:**
  - causes things to accelerate, but not always.
  - is an action, not a thing
  - is not a property of a body; a body can exert a force on another body.

How does force “act”

- **Push or pull by hands:** human action
- **sticking magnets:** magnetic force
- **sticky tape:** electrostatic force
  - Contact Forces
- **falling apple:** force of gravity
  - Action-at-a-Distance Forces

Newton's theory of gravity

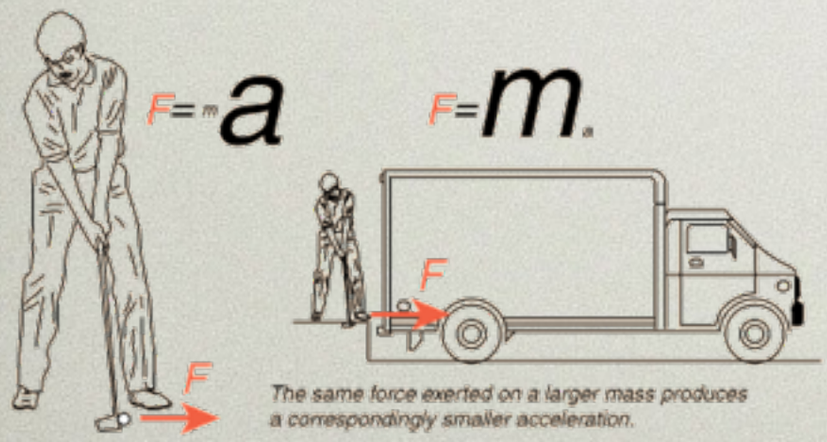


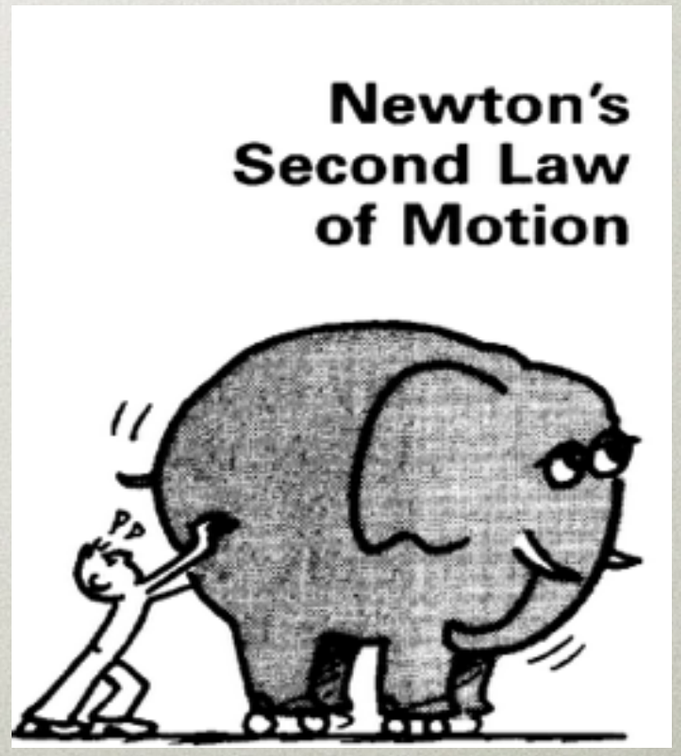
How did Newton verify his theory of gravity?

Connecting
Force and Acceleration

$$a = \frac{F}{m}$$

- Newton's law of motion





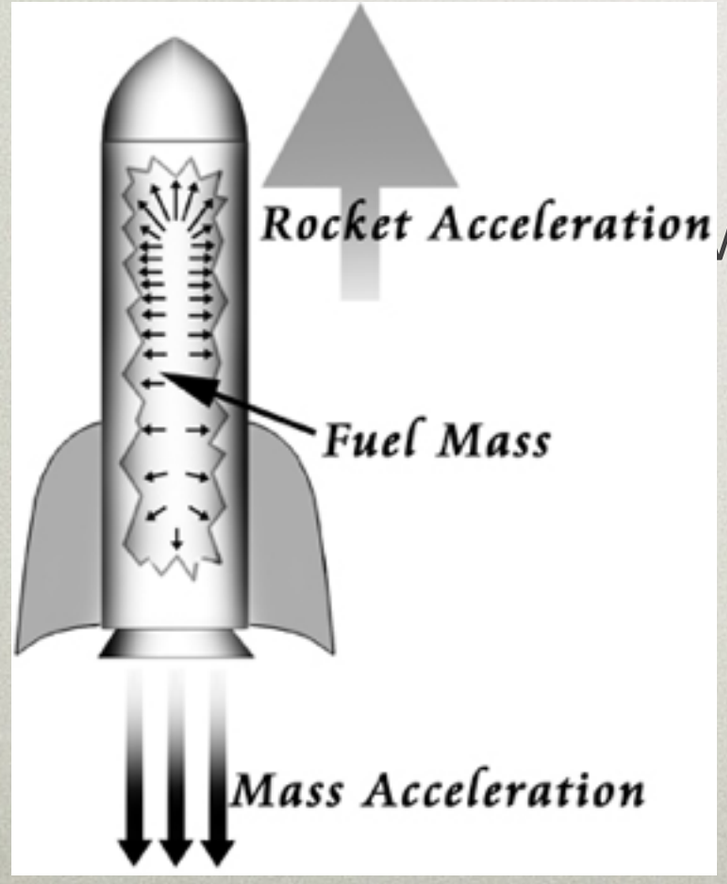
The Law of Force Pairs:

You can’t do just one thing

- The law of force pairs:

  Forces always come in pairs: Whenever one body exerts a force on a second body, the second exerts a force on the first. Furthermore, the two forces are equal in strength but

direction.



wn as “the Newton’s 3rd law”.

Measuring Motion:
Speed and Velocity

- Speed is the distance an object moves divided by the time it takes to move.
- What properties of the motion of an object do we need to know in order to know its speed?
- **Instantaneous speed**: The speed of an object at a specific **instant** in time.
- The difference between speed and velocity: scalars vs. vectors

Measuring Motion: Acceleration

- If an object's velocity is changing, it is accelerating. Acceleration is the rate of change of velocity:

  acceleration = (change in velocity)/ time

- Acceleration is measured in (m/s)/s, or m/s^2.