

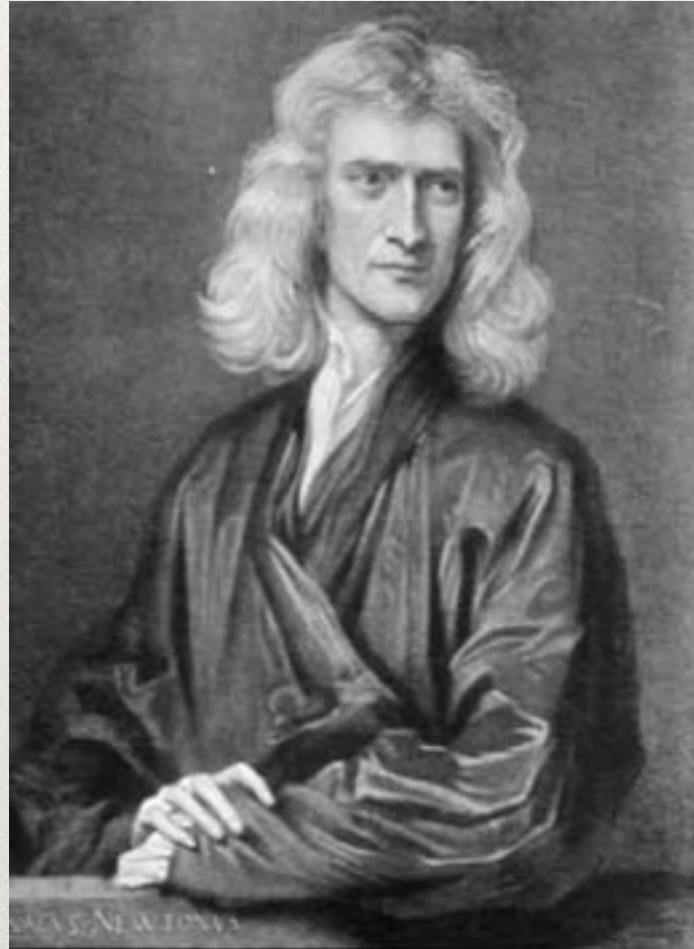
미시세계와 거시세계
3. 뉴턴의 사과
“힘과 운동”

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뉴턴

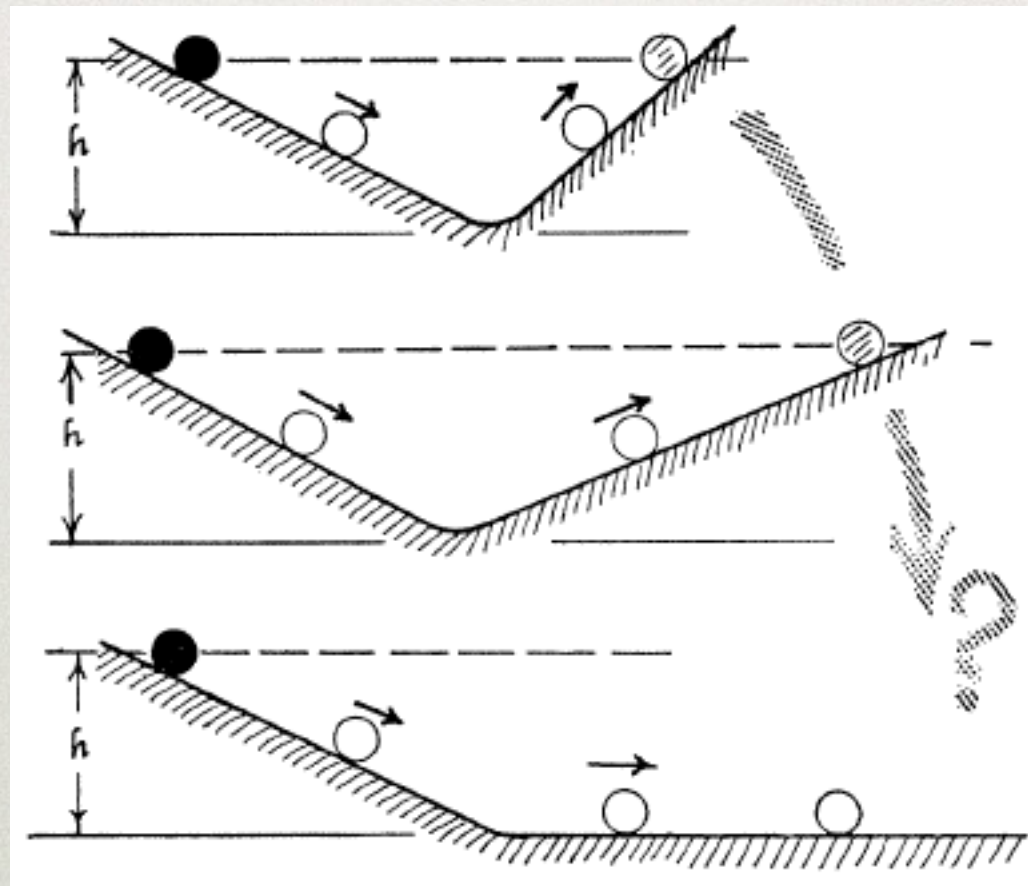


“If I have seen further it is by standing on the shoulders of giants.”



관성의 법칙

How do we know that the law of inertia works?



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.**



The Law of Inertia

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“Why things move as they do?”



뉴턴의 정원: "사과"와 "달"



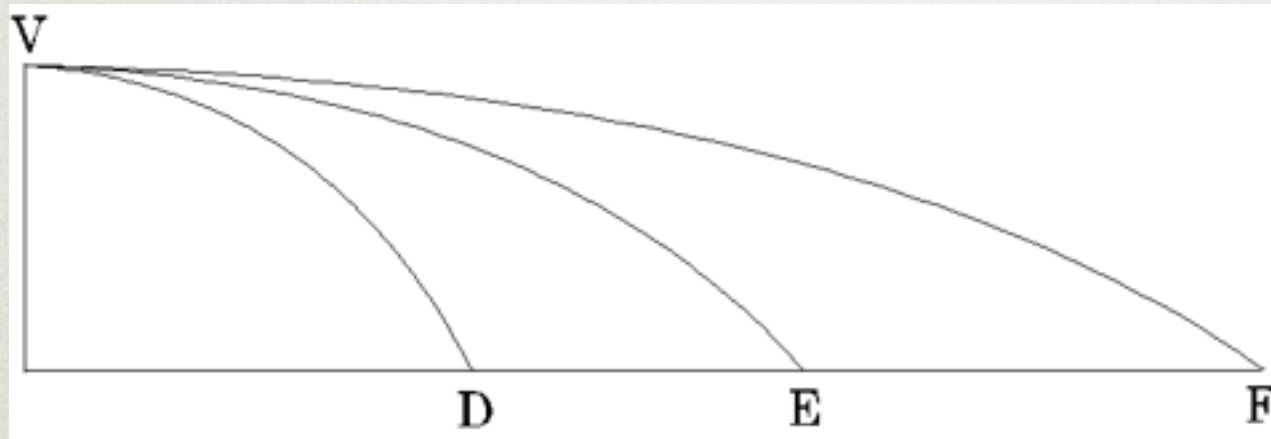
뉴턴의 정원: "사과"와 "달"



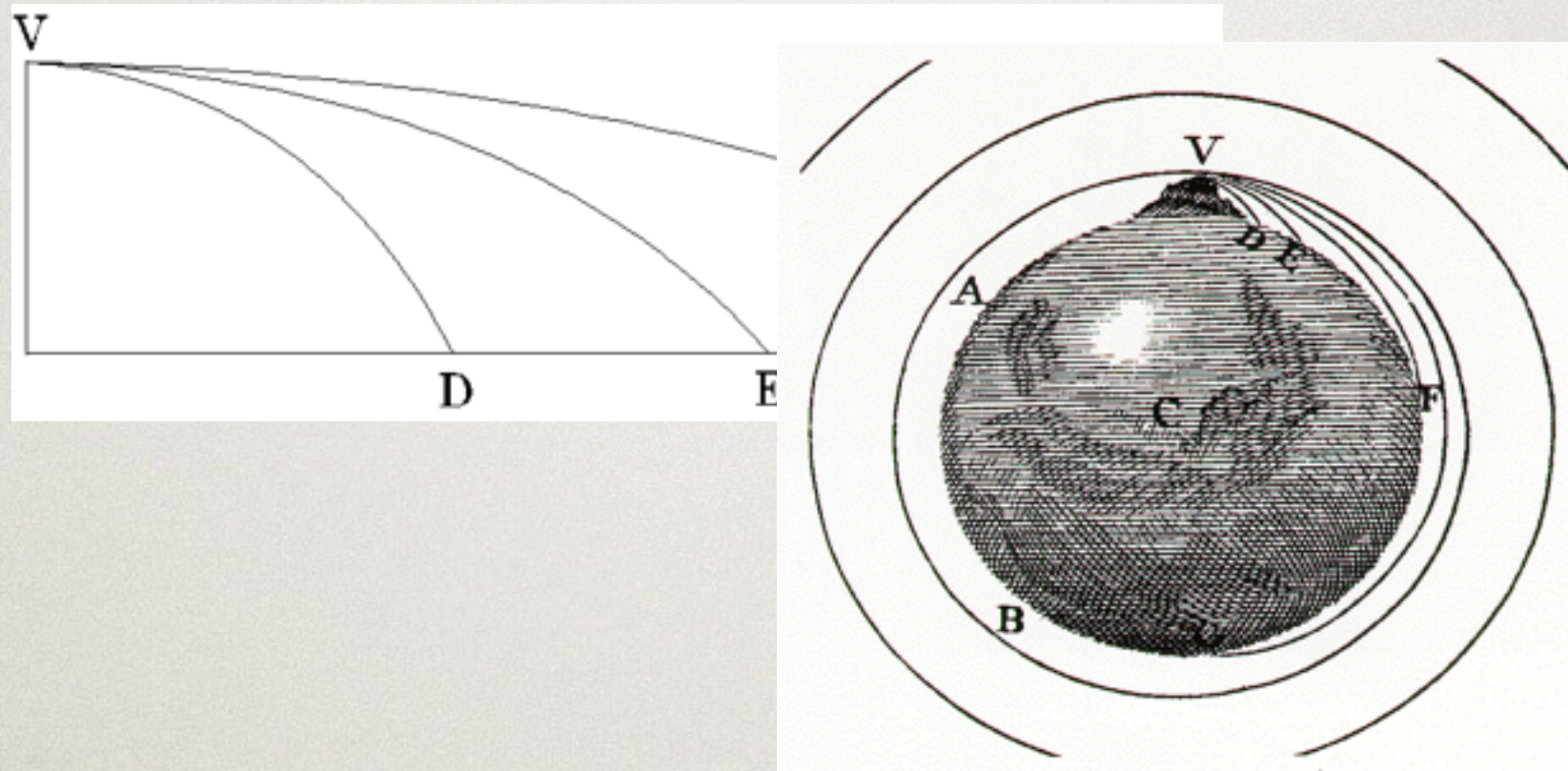
뉴턴의 정원: "사과"와 "달"



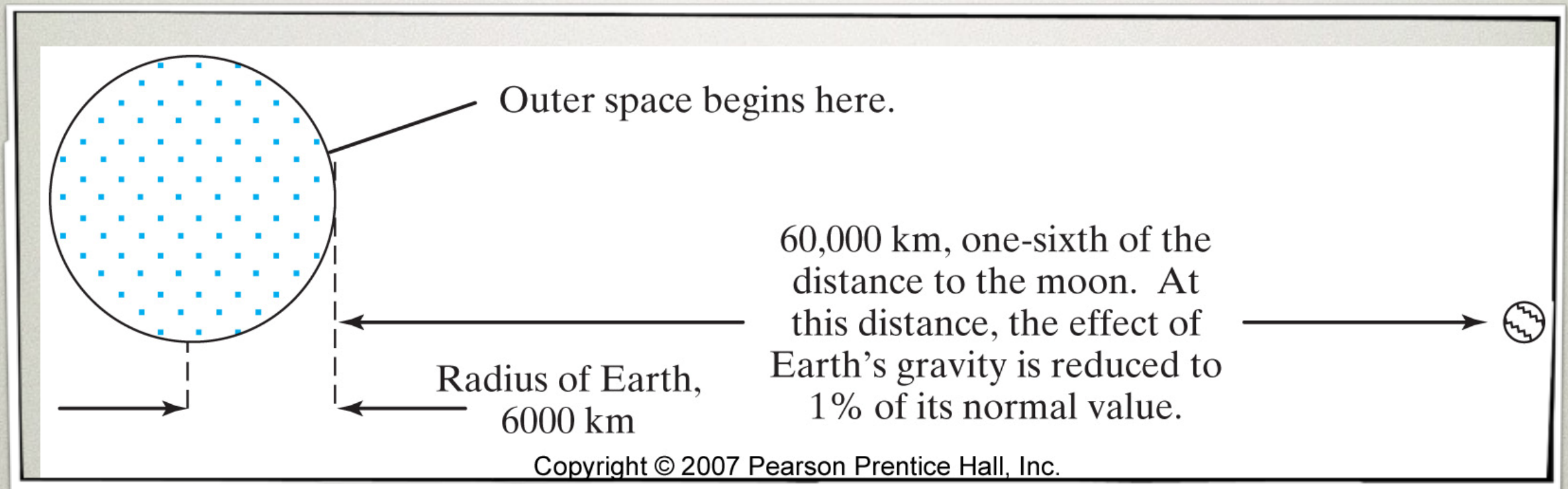
사과 멀리 날리기



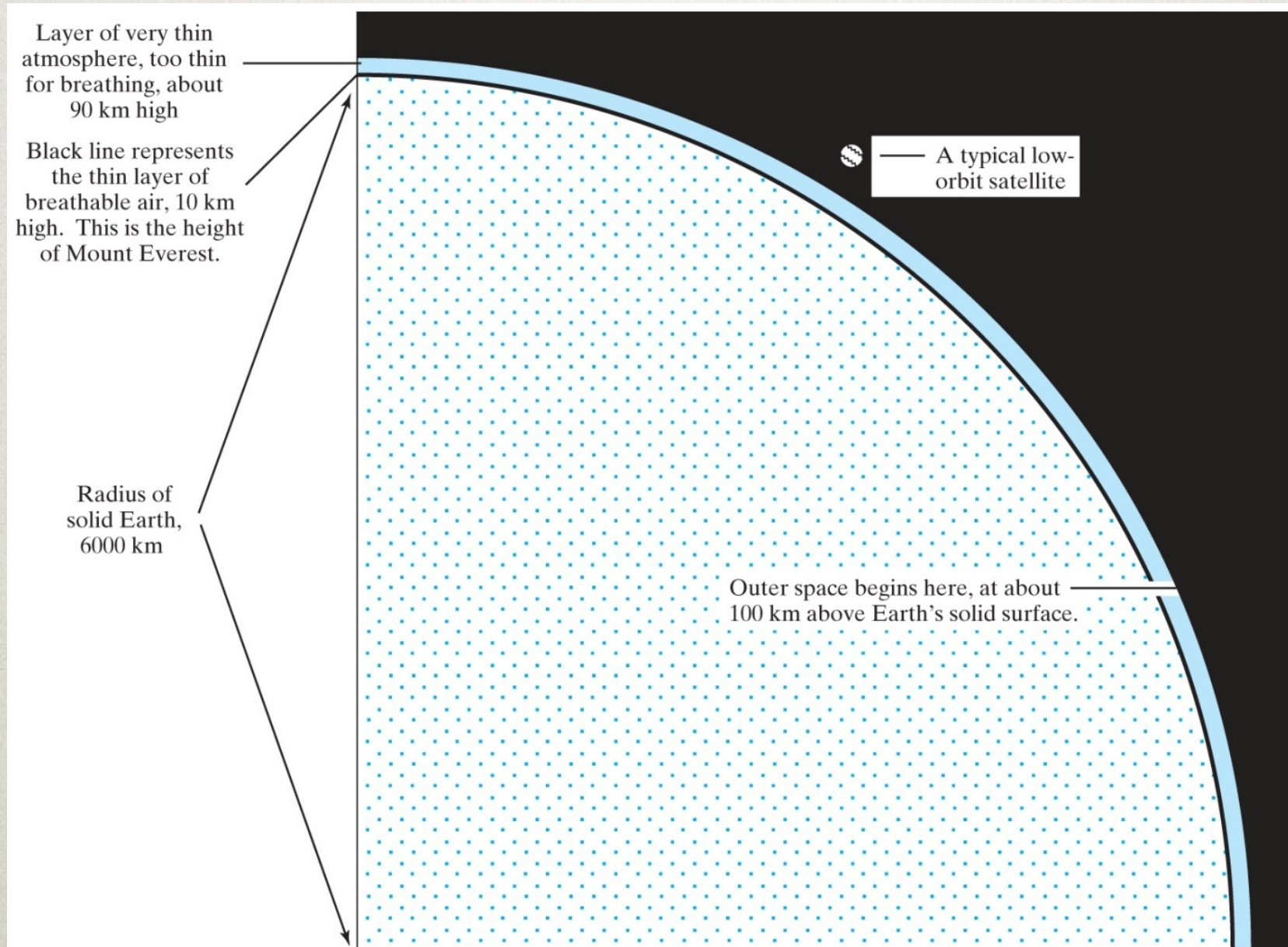
사과 멀리 날리기



“무중력 상태 (?)”



우주 공간은 얼마나 멀리 있는가?



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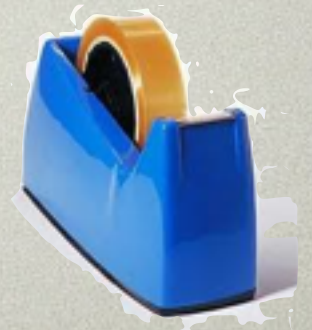
왜 물체는 가속을 하는가?

- **“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"

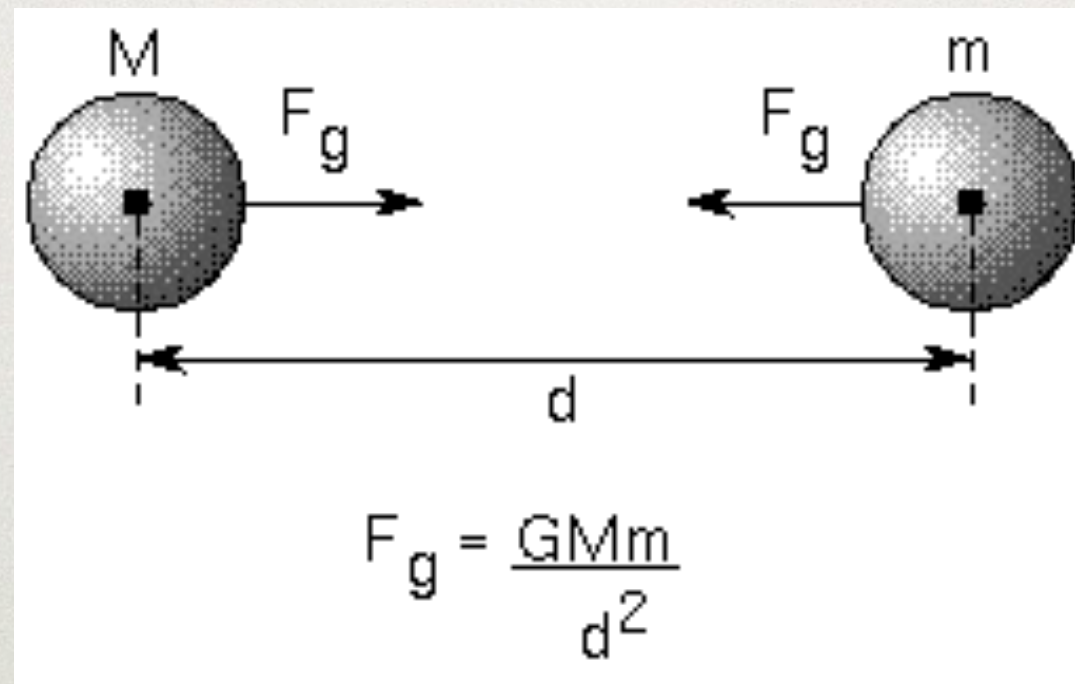
- **Push or pull by hands:** human action
- **sticking magnets:** magnetic force
- **sticky tape:** electrostatic force
 - Contact Forces
- **falling apple:** force of gravity
 - Action-at-a-Distance Forces



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Newton's theory of gravity



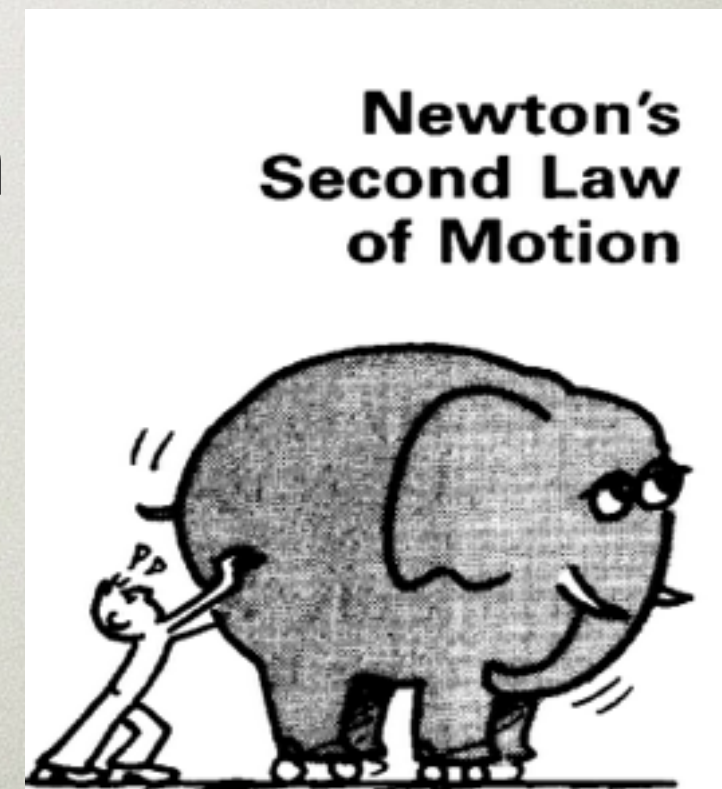
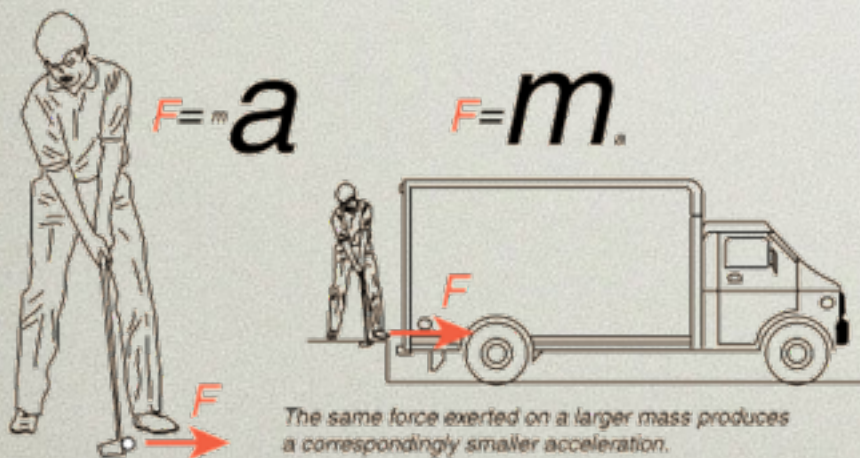
How did Newton verify his theory of gravity?



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

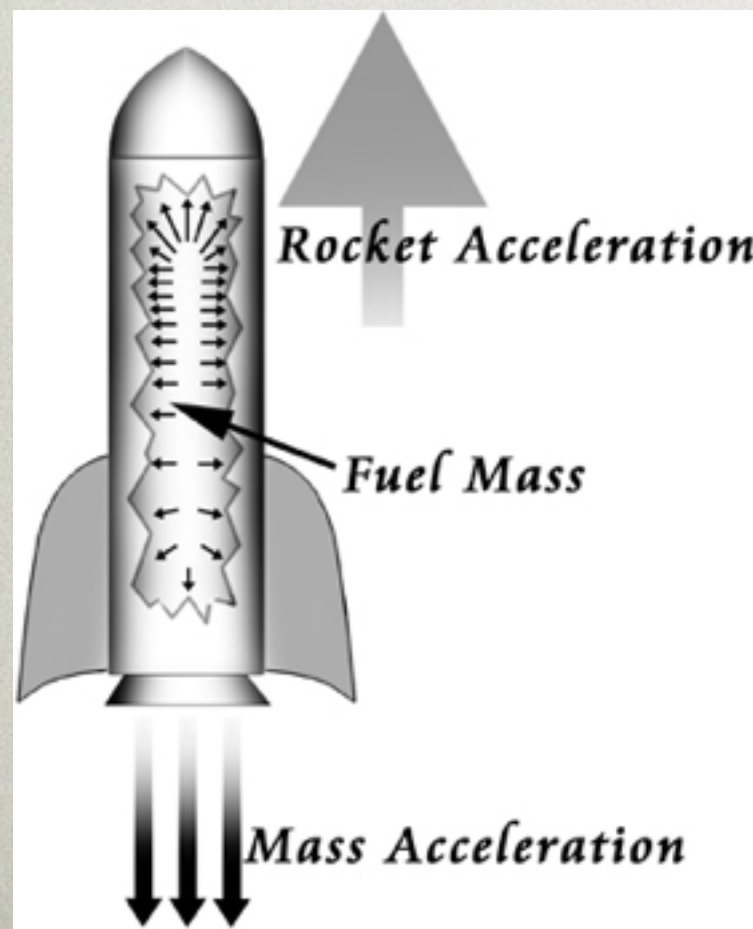
- The law of force pairs:
Forces always come in pairs: Whenever one body exerts a force on a second body, the second exerts a force on the first. Furthermore, the two forces are equal in strength but opposite in direction.

-- Also known as “the Newton’s 3rd law”.



The Law of Force Pairs: You can't do just one thing

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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:

$$\text{acceleration} = (\text{change in velocity}) / \text{time}$$

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

