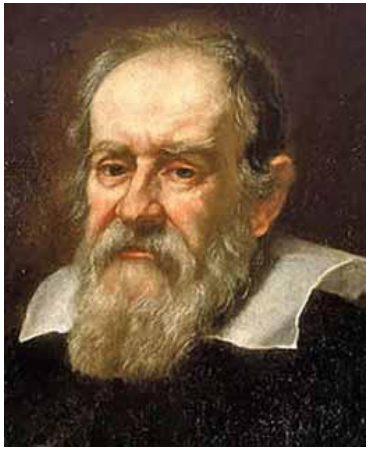



Famous Scientific Observations, Experiments and Demonstrations



#1 Equality of falling objects

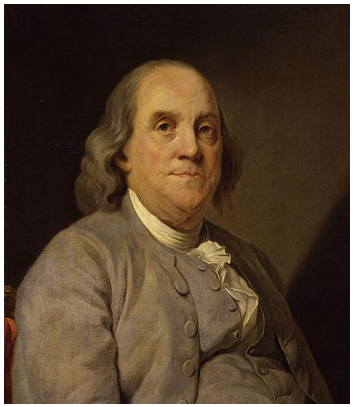
Galileo Galilei, early 1600s

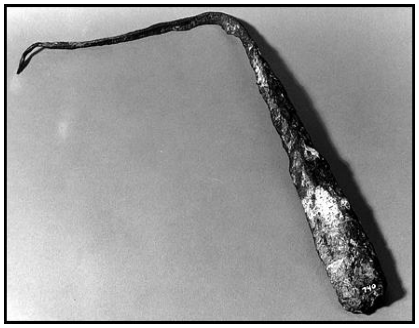


- **Common wisdom (Aristotle):**
  heavier objects fall faster than lighter ones.
- The story is now legendary: Galileo **dropped two different weights (balls)** from the top of the Leaning Tower of Pisa and **showed them landing at the same time**.
- **Result:** while *losing his job* as a mathematics professor at the University of Pisa for establishing a new fact, Galileo became famous throughout the continent…
- **Demonstration repeated:** Apollo astronauts dropped a feather and a hammer on the moon, again demonstrating Galileo's equality of falling bodies. This was possibly the "most watched experiment" of all time…

#2 Kite experiment

Benjamin Franklin, 1752





- Franklin proposed an experiment to prove that **lightning is electricity** by *flying a kite in a storm* that appeared capable of becoming a lightning storm.
- According to the legend, Franklin kept the string of the kite dry at his end to insulate him while the rest of the string was allowed to get wet in the rain to provide conductivity. A key was attached to the string and connected to a Leyden jar (an early form of capacitor), which Franklin assumed would accumulate electricity from the lightning.
- **"…the sameness of the electrical matter with that of lightning completely demonstrated."**
- Franklin's electrical experiments led to his **invention of the lightning rod**.

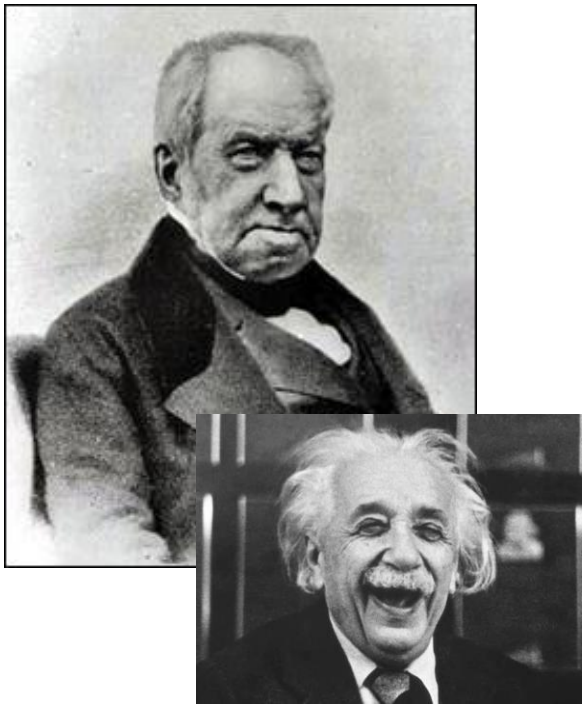
#3 Foucault's Pendulum

Leon Foucault, 1851

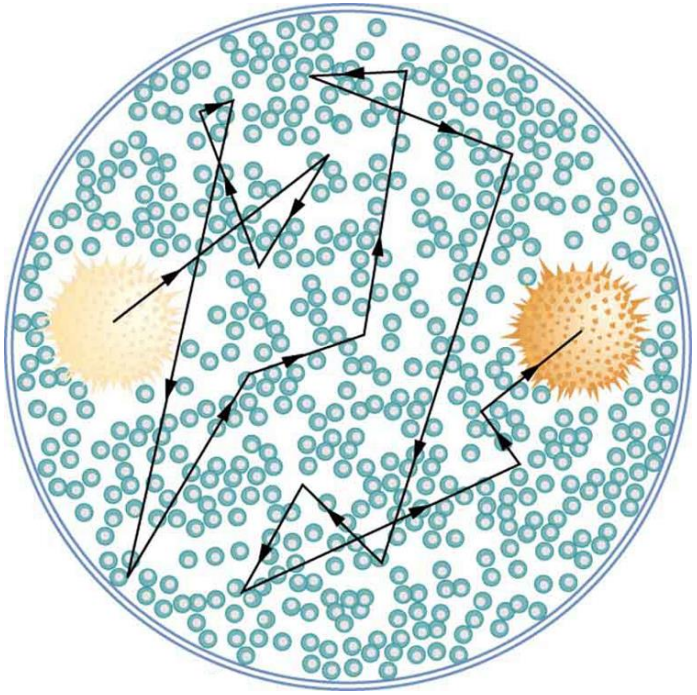
- **Demonstration showing that the Earth revolves on its axis.**
- A 62-pound iron ball was suspended from 220 feet long steel wire attached to the dome of the Panthéon and set in motion. A marker extending from the ball barely touched a circle of damp sand underneath.
- **Common wisdom:** the pendulum will *trace the same places* over and over again.
- **In reality**, the **pendulum appeared to shift positions** leaving a slightly different trace with each swing.
- **The reason: the Earth** and therefore the floor **was rotating**!

#4 Brownian motion

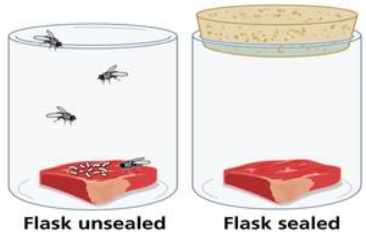
Robert Brown, 1827



- In 1827, while looking through a microscope at particles found in pollen grains in water, **Brown noted that the particles moved through the water** but was not able to determine the mechanisms that caused this motion.



- **Albert Einstein, 1905:** Any minute particle suspended in a liquid (or gas) moves chaotically under the action of collisions with surrounding molecules. The intensity of this chaotic motion is increased with an increase in temperature.
- This explanation of Brownian motion served as **definitive confirmation** that **atoms and molecules actually exist**.

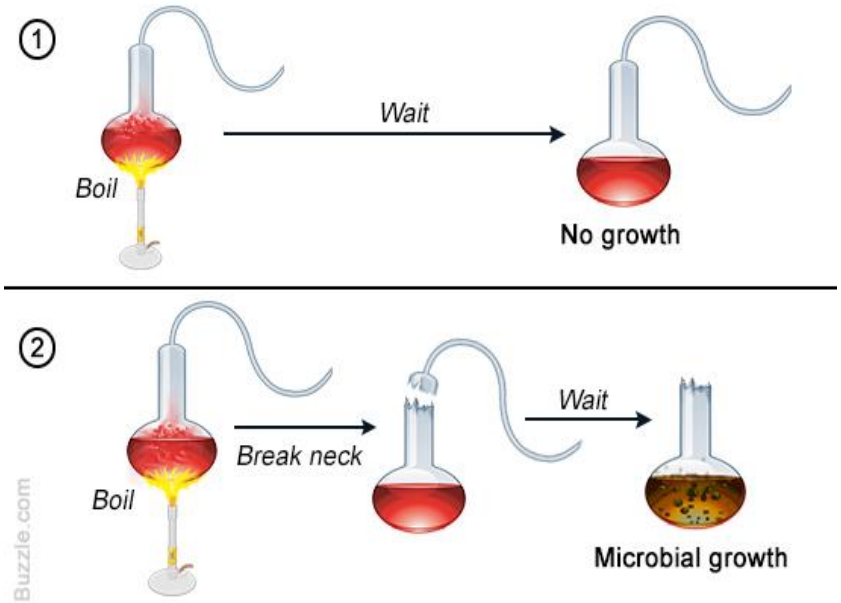


Early experiments by Francesco Redi, 1668

#5 Swan-neck flasks

Louis Pasteur, 1864

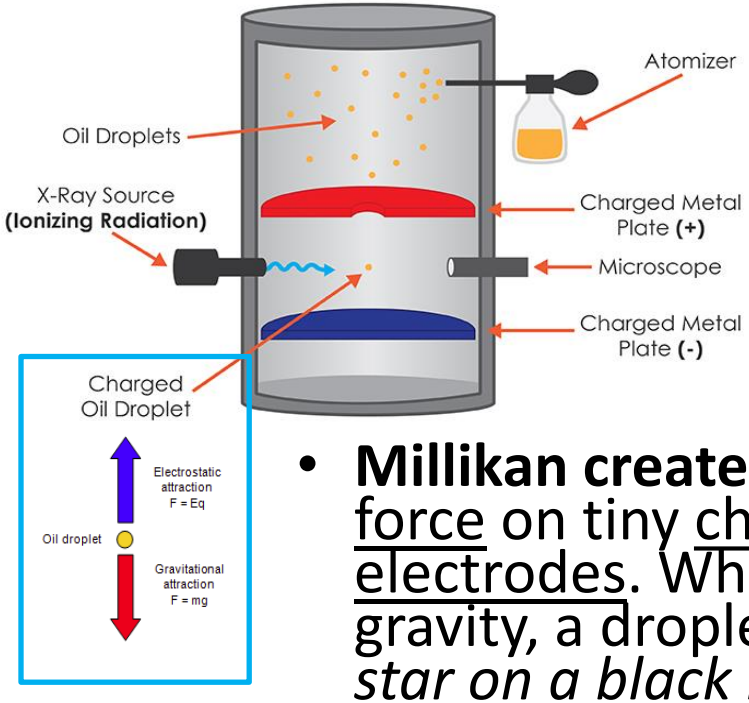
- **Demonstrated that organisms such as bacteria and fungi *do not spontaneously appear* in sterile, nutrient-rich media, but only invade them from outside.**
- The theory of Spontaneous Generation (1861): *living things can originate from non-living*.
- Pasteur exposed boiled broths to air in vessels that had open long s-shaped necks that would not allow dust particles to pass to the growth medium.



- **Nothing grew** in the broths unless the flasks were broken open, thus **disproving the theory of spontaneous generation**.

#6 Oil-drop experiment

Robert Millikan, 1909



- ***1923 Nobel Prize in Physics*** for his measurement of the **elementary electronic charge** (and for his work on the photoelectric effect).
- **Before:** Joseph Thomson had shown that electricity consisted of negatively charged particles (electrons).
- **Millikan created a *special device*** and measured the force on tiny charged droplets of oil between two metal electrodes. When the electrical force matched that of gravity, a droplet would hover in midair "*like a brilliant star on a black background*".
- Repeating the experiment for many droplets, he showed that the **total charge on the droplet** could be described as **integer multiples of a common value** - the **charge of a single electron**.