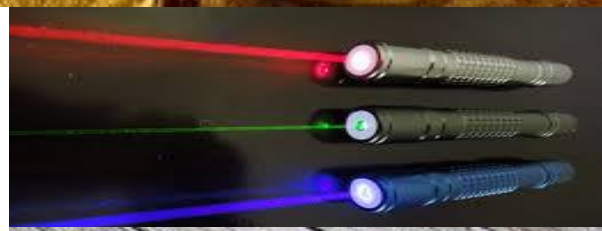
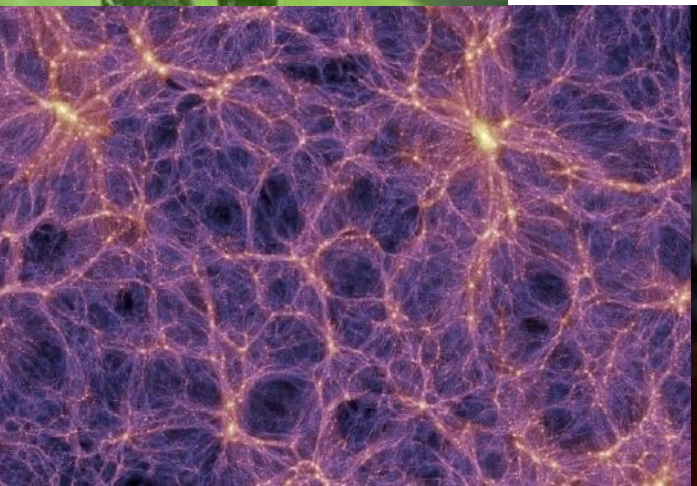



OH DEAR, WHAT CAN THE

MATTER

BE?





What is Matter?

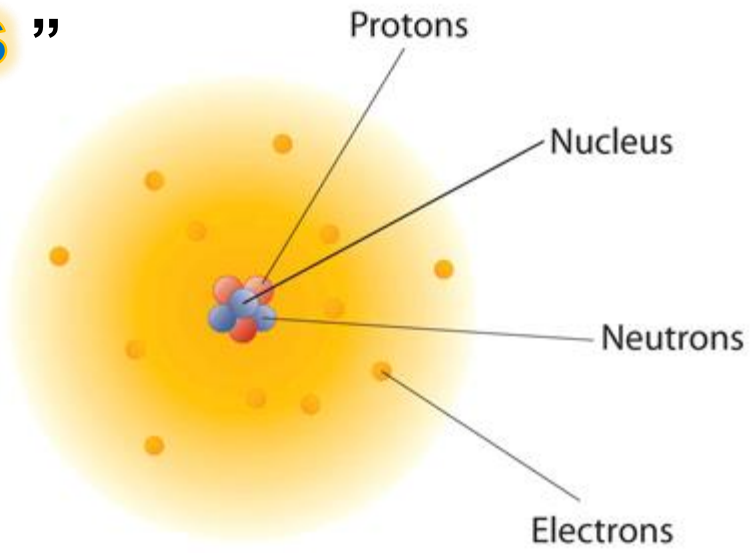
1. **Common "classical" definition (known as *mechanical, abstract mathematical*), René Descartes, Isaac Newton - 17th century:**

"Matter is anything that has mass and takes up space"

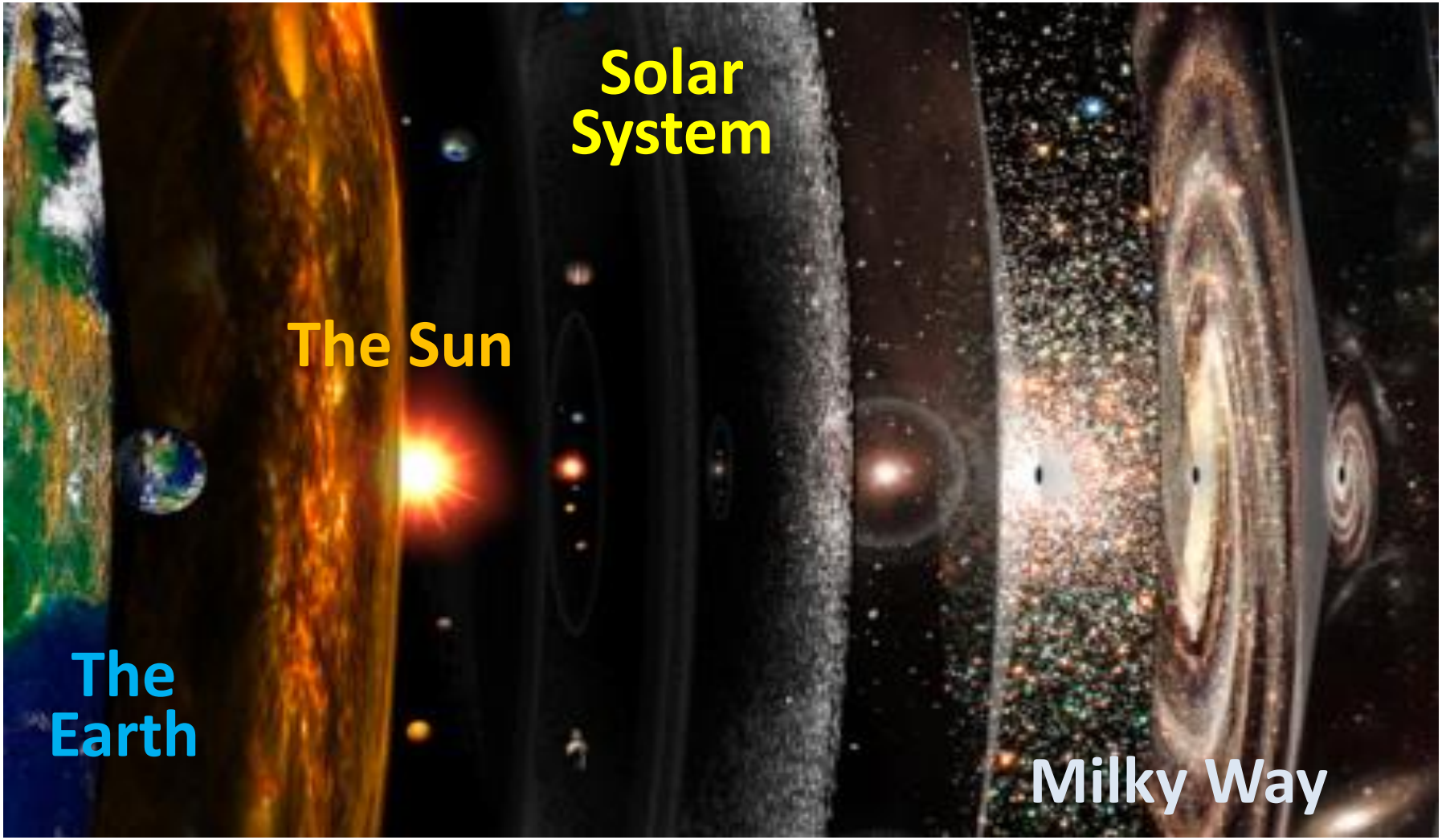
2. **Late 19th century definition (based on physical and chemical structure):**

"Matter is made up of atoms"

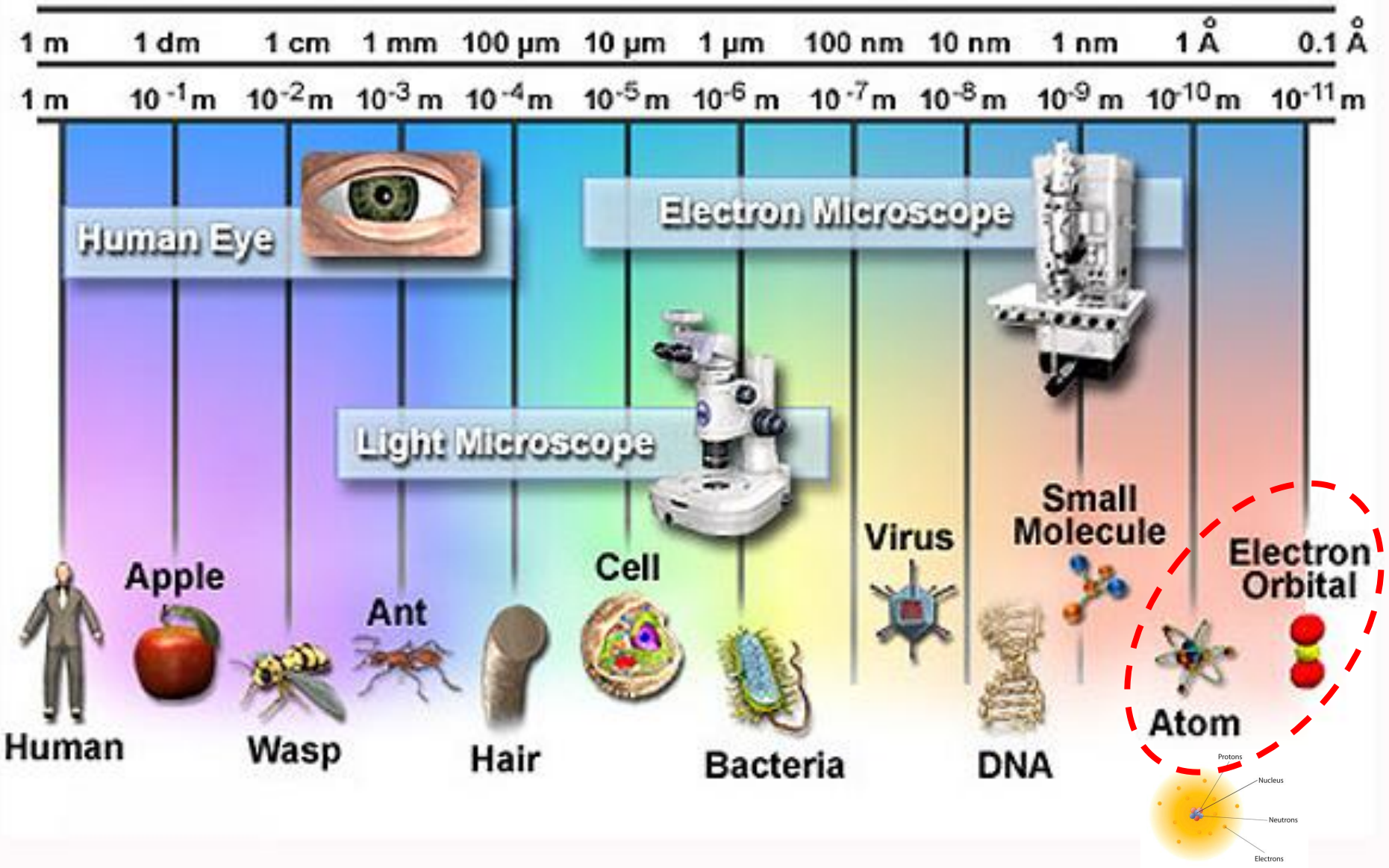
This *atomic*, or *ordinary*, matter is in turn made up of interacting *subatomic particles* — usually a nucleus of *protons* and *neutrons*, and a cloud of orbiting *electrons*.



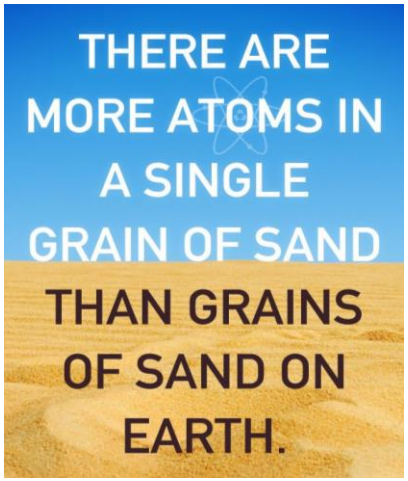
Some Bigger (>1 million m) Things



Some Smaller (<1 m) Things



Voyage into the World of Atoms

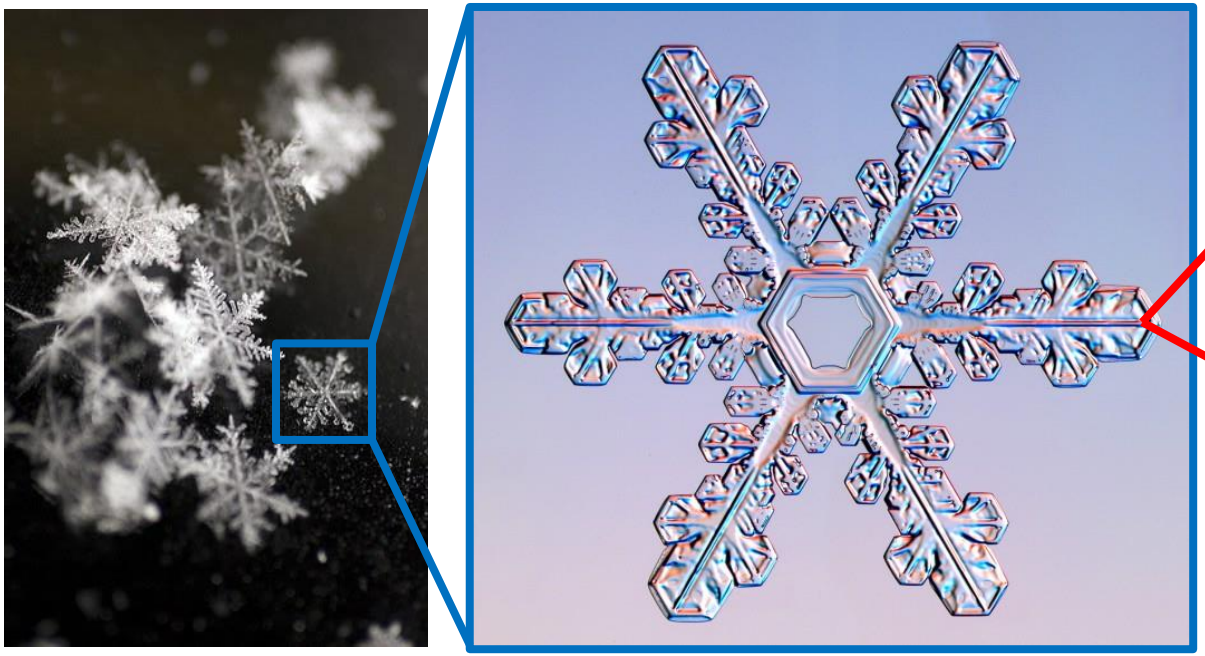


Atoms are very small!

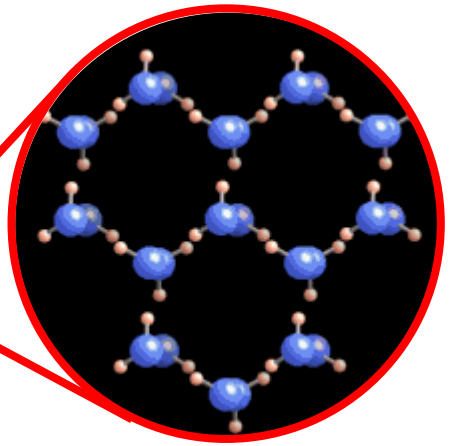
Voyage into the World of Atoms:

https://www.youtube.com/watch?v=7WhRJV_bAiE

Snowflake ~1-3 mm



Ice crystal unit cell 5 nm



Single atom ~1Å=10^{-10} m

A typical snowflake is made of about 10^{18}-10^{19} atoms.

Study of Matter

- **Physics** – ***physical science*** **that studies forms of matter, its change and motion through space-time, and related concepts such as energy and force.**
- **Chemistry** – ***physical science*** **that studies material substances, their composition and change of composition (chemical reactions), as well as matter behavior related to chemical reactions.**

Physical science – branch of natural science that studies non-living systems.

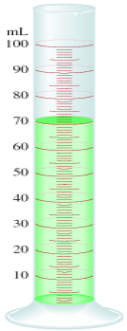
Natural science – major branch of science, that tries to explain and predict nature's phenomena, based on empirical evidence.

Science – systematic effort of acquiring knowledge—through observation and experimentation coupled with logic and reasoning.

Physical Properties of Matter

We can describe <u>physical properties</u> of matter in terms of physical quantities and laws.

- **An *<u>extensive</u>* property depends upon how much matter is being considered:**
  - **mass**
  - **volume**
  - **electrical charge**



- **An *<u>intensive</u>* property does *<u>not</u>* depend upon how much matter is being considered:**
  - **density**
  - **temperature**
  - **color**

  - **elasticity**
  - **metallicity**
  - **solubility etc…**