Length scales in Nature

1 mm

1 km

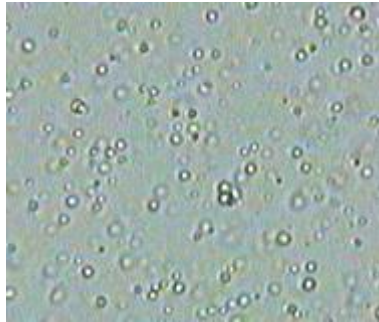**Grain of sugar, small insects, etc**
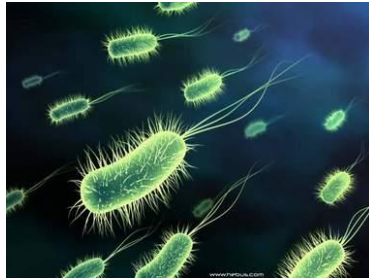
Brooklyn bridge

10^{-3} m   1 m 10^{3} m

1 micron (1μm)

Particles in smoke, milk, etc (1-20 μm)

Bacteria (1-10 μm)

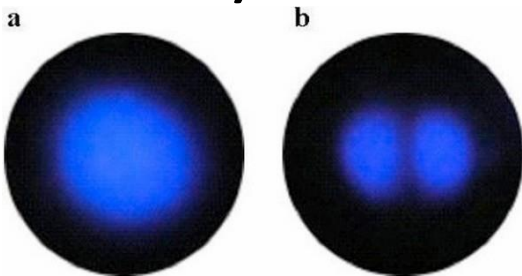**Human Chromosome (2 -10 μm)**
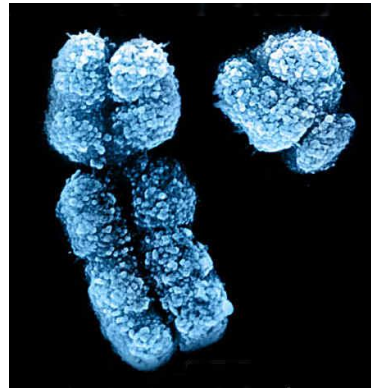
1000 km

10^{-6} 10^{-3} 1 m 10^{3} 10^{6}

1 nanometer = 10 Angstrom
(1 nm =10 Å)
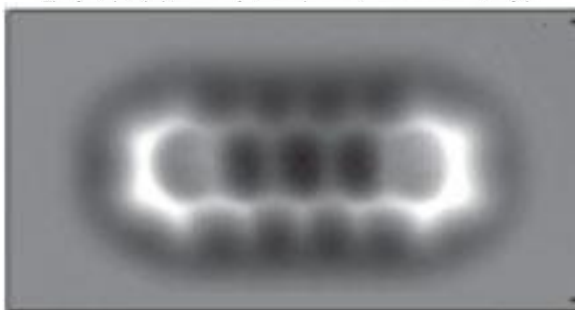
1,000,000 km
(3 light seconds)

Atom (1 Å)

Molecule
(1nm)

Virus (>10 nm)

10^{-9} 10^{-6} 10^{-3} 1 m 10^{3} 10^{6} 10^{9}

Proton, neutron, atomic nucleus

1 fm

1 Å = 100,000 fm
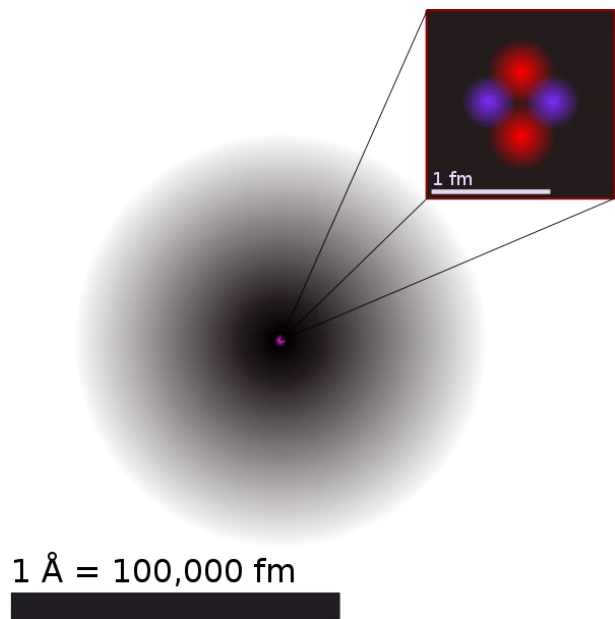
10^{12} m = 1 billion km ≈ 1 light hour

10^{16} m ≈ 1 light year

Alpha Centauri A & B

Proxima Centauri

41,200,000,000,000 km

39,900,000,000,000 km

Sun

10^{-15} 10^{-12} 10^{-9} 10^{-6} 10^{-3} 1 m 10^{3} 10^{6} 10^{9} 10^{12} 10^{15}
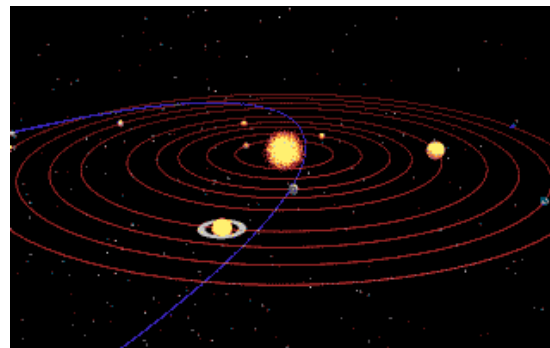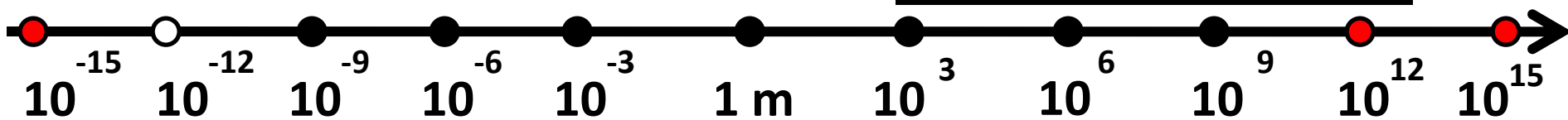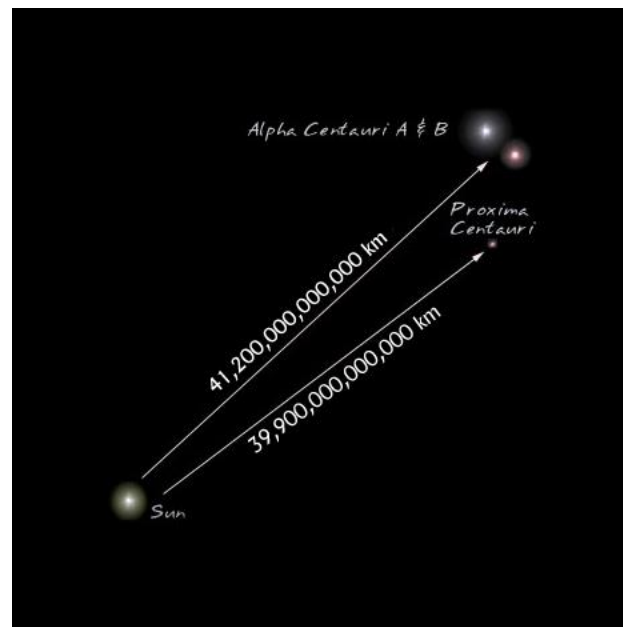
Modern Physics

High Energy Physics

Condensed Matter Physics

Astrophysics & Cosmology

Large Hadron Collider (LHC)

Carbon Nanotubes

Our Galaxy (Milky Way)

?

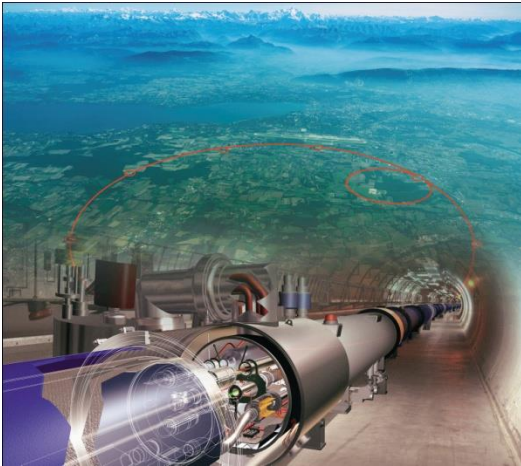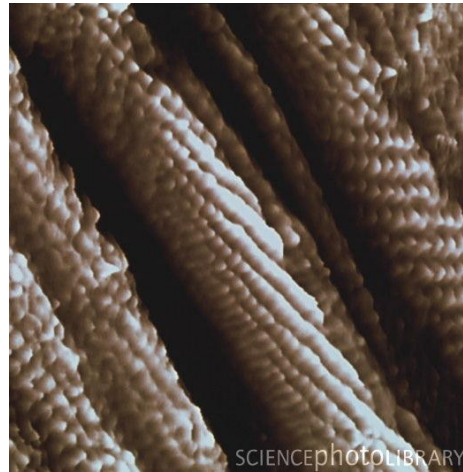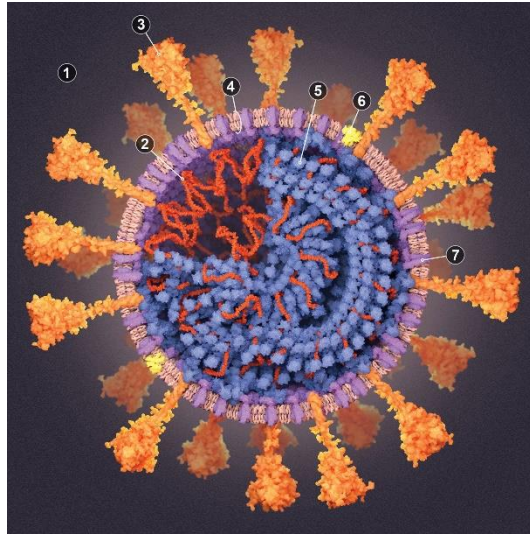10^{-35} 10^{-21} 10^{-15} 1 m 10^{15} 10^{21} 10^{27}
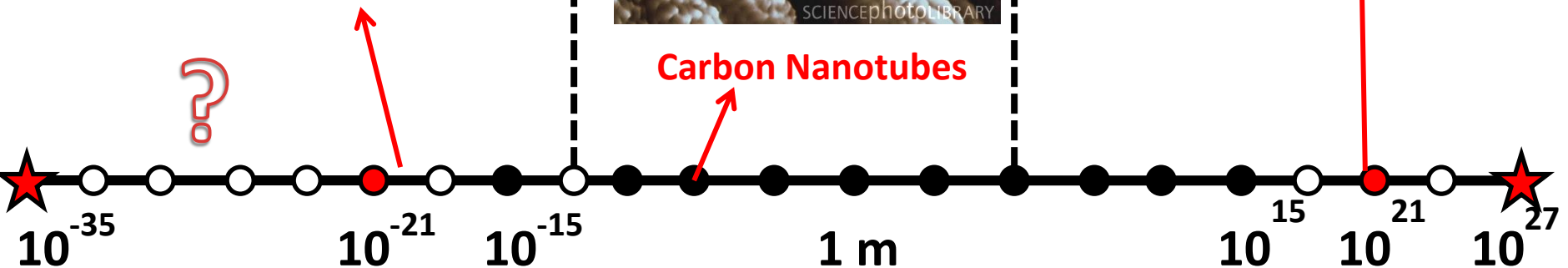
about 100 nm = 0.1 μm

The difference between droplet and airborne transmission

Droplet transmission
Coughs and sneezes can spread droplets of saliva and mucus

Airborne transmission
Tiny particles, possibly produced by talking, are suspended in the air for longer and travel further

Less than 5 microns

Droplets

Human hair:
60 - 120 microns wide

More than 5 microns
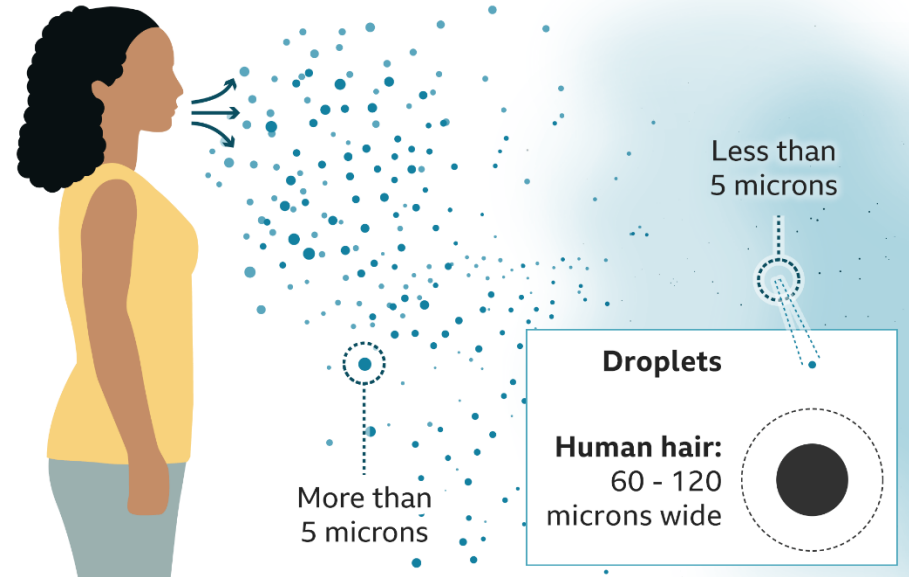
Source: WHO

BBC

pore size: < 0.3 μm   1..10 μm   about 10 μm   about 100 μm (0.1 mm)

N95   **Surgical masks**   **Cotton masks**   **Cloth coverings**

Homework 1

Problem 1.

Estimate the number of cells in your body, by approximating a single cells as a cube sized 10x10x10 micron. ***Hint:*** if you know your mass, you know your volume.

Problem 2.

Once a person is infected with COVID-19, the virus starts multiplying. In approximately 5 days, at the moment of when the symptom of the disease appear, 1 ml of patient's saliva may contain as many as 10^7 viruses.
A single cough can generate about 1000 droplets, each approximately 50 micron in radius   (there are also smaller droplets which we neglect). Estimate, how many viruses are carries by a single cough of a patient at the time of the symptom onset .