Length scales in Nature

1 mm

Grain of sugar, small insects, etc

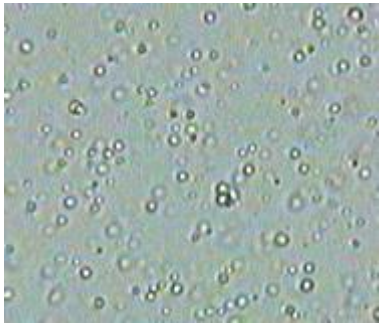
1 km

Brooklyn bridge

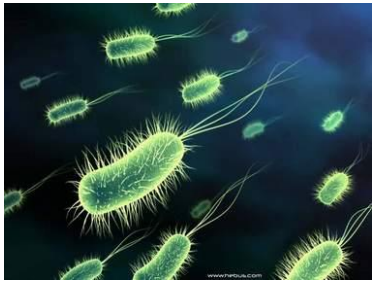
10^{-3} m 1 m 10^{3} m

1 micron (1μm)

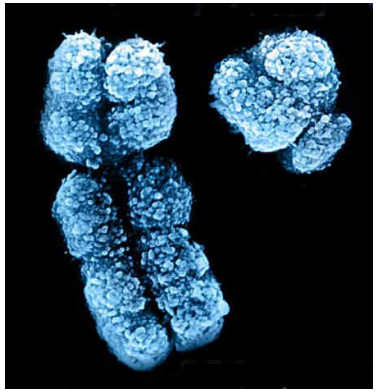
Particles in smoke, milk, etc
(1-20 μm)



Bacteria
(1-10 μm)



Human Chromosome
(2 -10 μm)



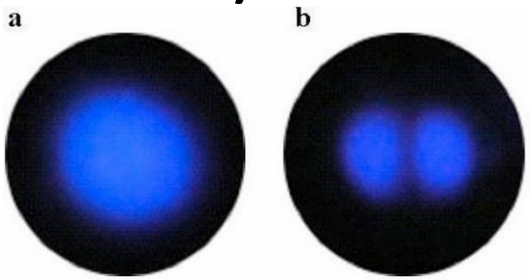
1000 km

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

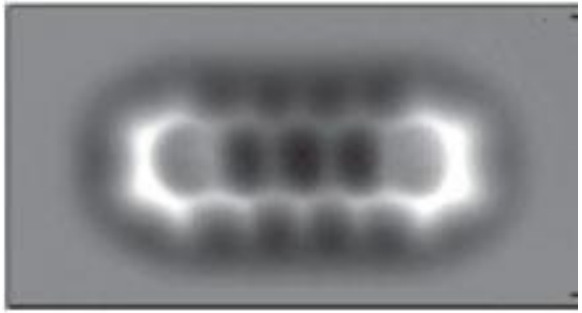
1 nanometer = 10 Angstrom
(1 nm =10 Å)

1,000,000 km
(3 light seconds)

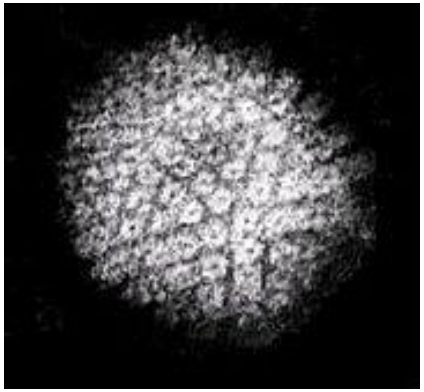
Atom (1 Å)

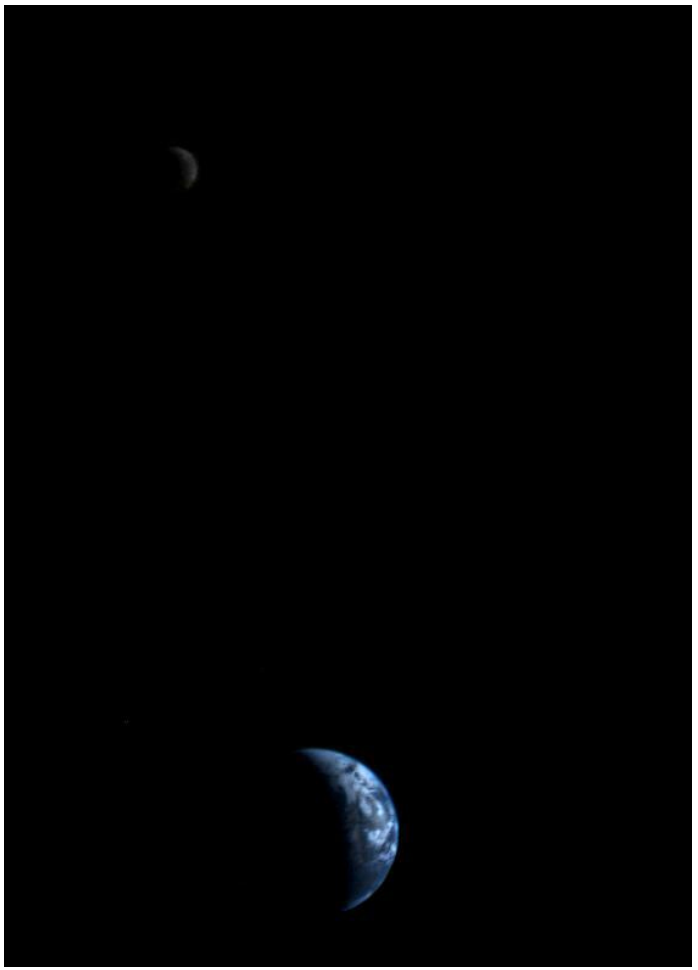


Molecule
(1nm)



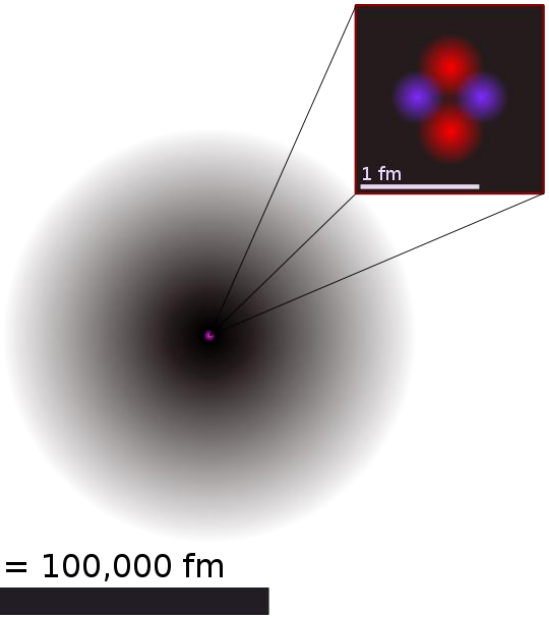
Virus (>10 nm)



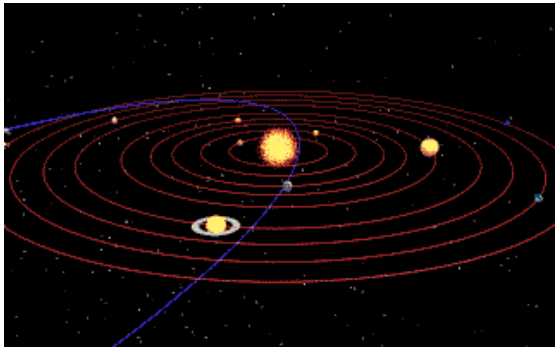


10^{-9} 10^{-6} 10^{-3} 1 m 10^{3} 10^{6} 10^{9}

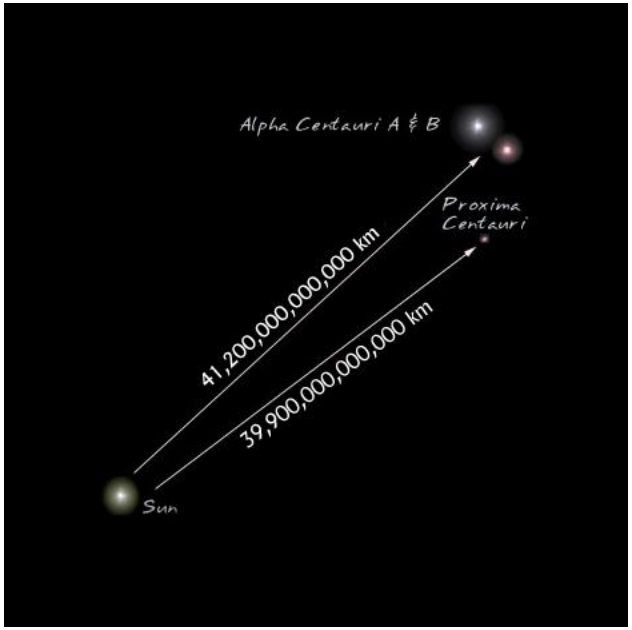
Proton, neutron, atomic nucleus



10^{12} m = 1 billion km ≈ 1 light hour



10^{16} m ≈ 1 light year



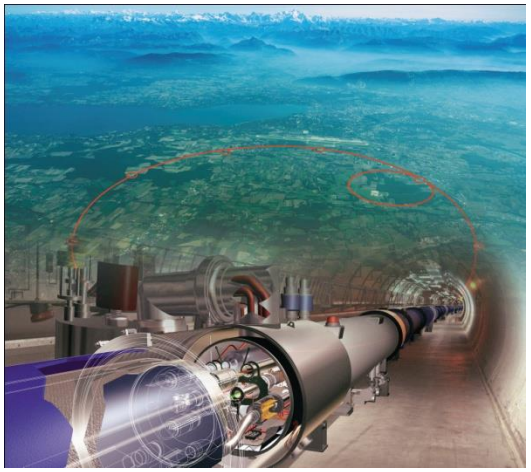
10^{-15} 10^{-12} 10^{-9} 10^{-6} 10^{-3} 1 m 10^{3} 10^{6} 10^{9} 10^{12} 10^{15}

Modern Physics

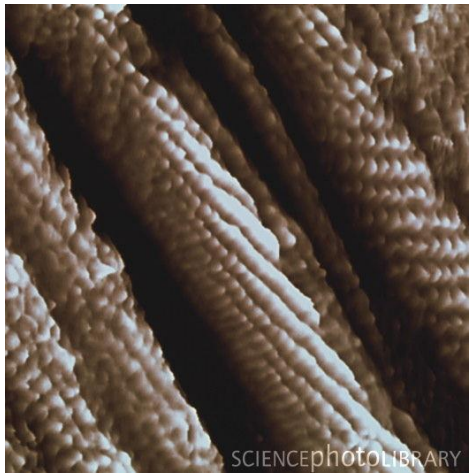
High Energy Physics

Condensed Matter Physics

Astrophysics & Cosmology



Large Hadron Collider (LHC)

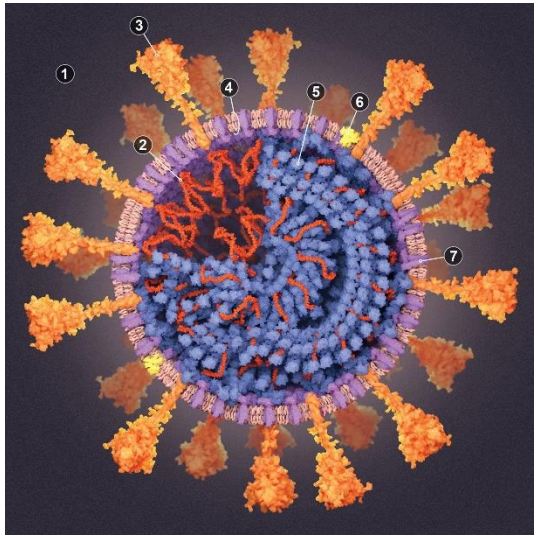


Carbon Nanotubes

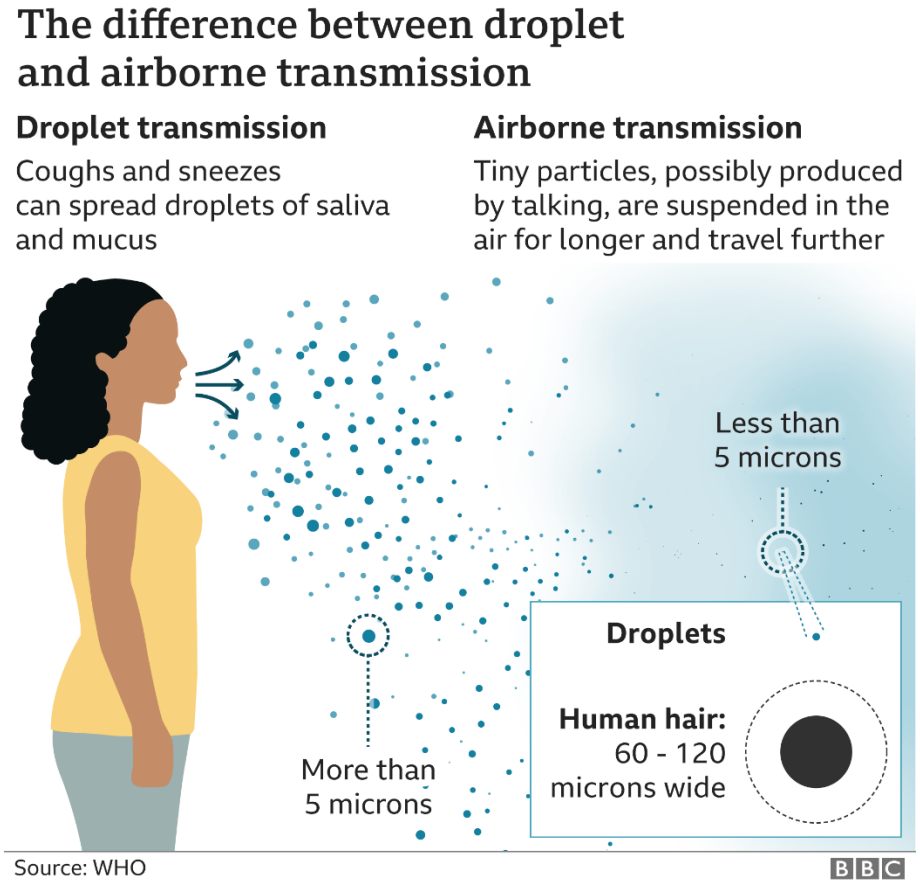
Our Galaxy (Milky Way)

?

10^{-35} 10^{-21} 10^{-15} 1 m 10^{15} 10^{21} 10^{27}



about 100 nm = 0.1 μm



pore size: < 0.3 μm

N95

1..10 μm

Surgical masks

about 10 μm

Cotton masks

about 100 μm (0.1 mm)

Cloth coverings

Homework 1

Problem 1.

Water molecule can be approximated as a sphere of radius 2 Å (1Å=10^{-10}m, is called Angstrom). Estimate how many molecules is there in 1 cm^3 of water.

Problem 2.

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.