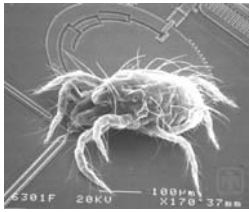


# The Scale of Things - Nanometers and More

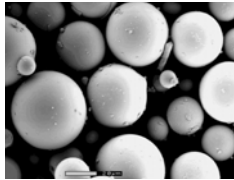
## Things Natural



Dust mite  
200  $\mu\text{m}$



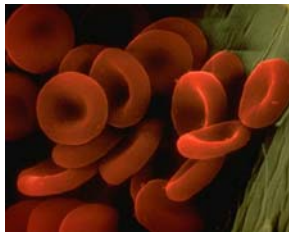
Ant  
~ 5 mm



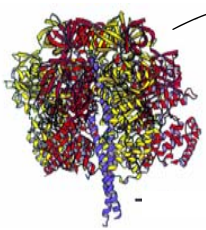
Fly ash  
~ 10-20  $\mu\text{m}$



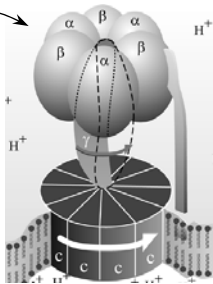
Human hair  
~ 60-120  $\mu\text{m}$  wide



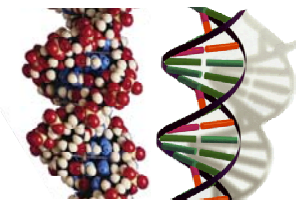
Red blood cells  
(~7-8  $\mu\text{m}$ )



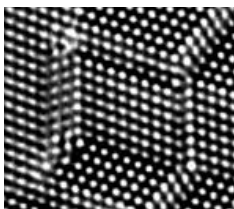
~10 nm diameter



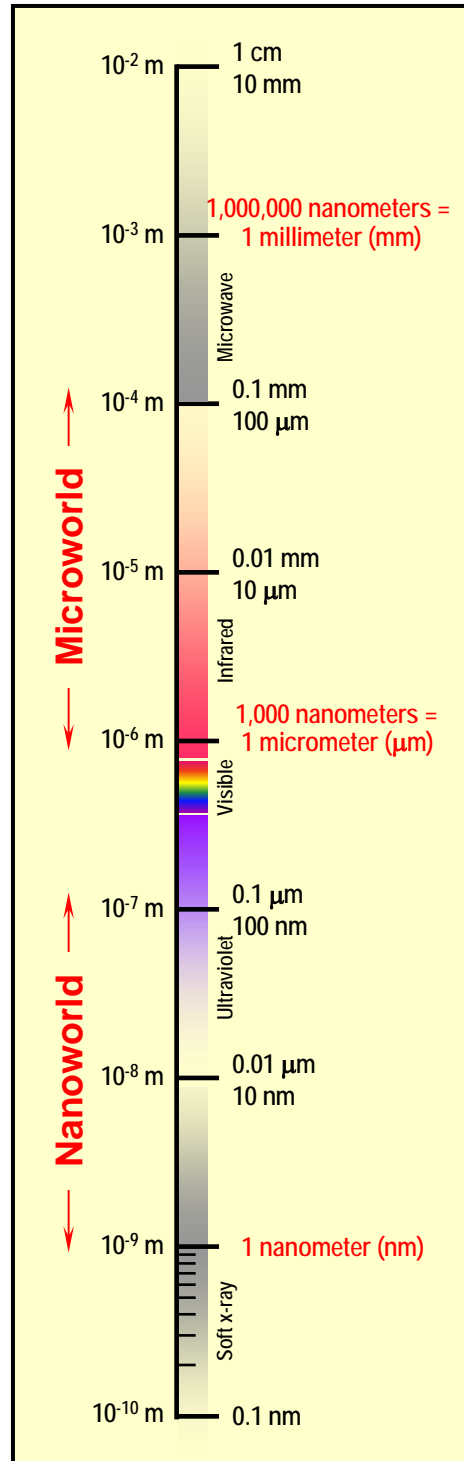
ATP synthase



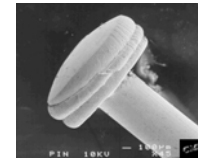
DNA  
~2-1/2 nm diameter



Atoms of silicon  
spacing ~tenths of nm



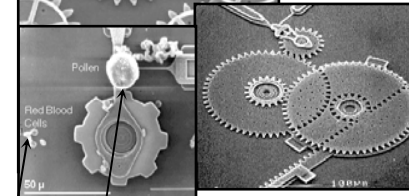
## Things Manmade



Head of a pin  
1-2 mm



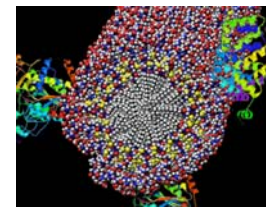
MicroElectroMechanical (MEMS) devices  
10 -100  $\mu\text{m}$  wide



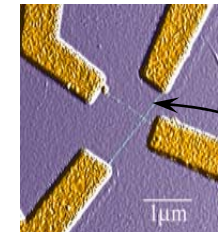
Pollen grain  
Red blood cells



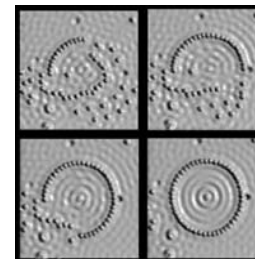
Zone plate x-ray "lens"  
Outer ring spacing ~35 nm



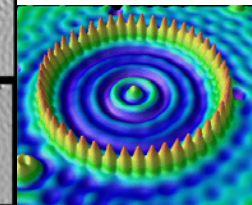
Self-assembled,  
Nature-inspired structure  
Many 10s of nm



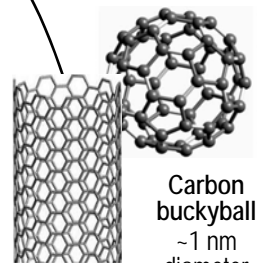
Nanotube electrode



Quantum corral of 48 iron atoms on copper surface  
positioned one at a time with an STM tip  
Corral diameter 14 nm



Carbon nanotube  
~1.3 nm diameter



Carbon buckyball  
~1 nm diameter

### The Challenge

*Fabricate and combine nanoscale building blocks to make useful devices, e.g., a photosynthetic reaction center with integral semiconductor storage.*