THE SCALE OF THINGS

Things Natural

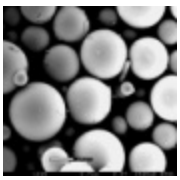
Cat
~ 0.3 m

Monarch butterfly
~ 0.1 m

Bee
~ 15 mm

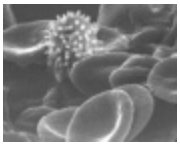
Dust mite
300 µm

Human hair
~ 50 µm wide



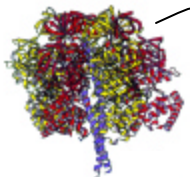
Fly ash
~ 10-20 µm

Magnetic domains
garnet film
11 µm wide stripes



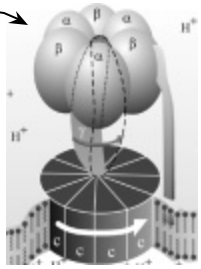
Red blood cells
with white cell
~ 2-5 µm

Schematic, central core

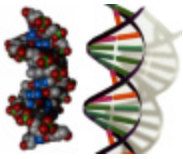


10 nm

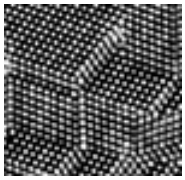
ATP synthase



Cell membrane

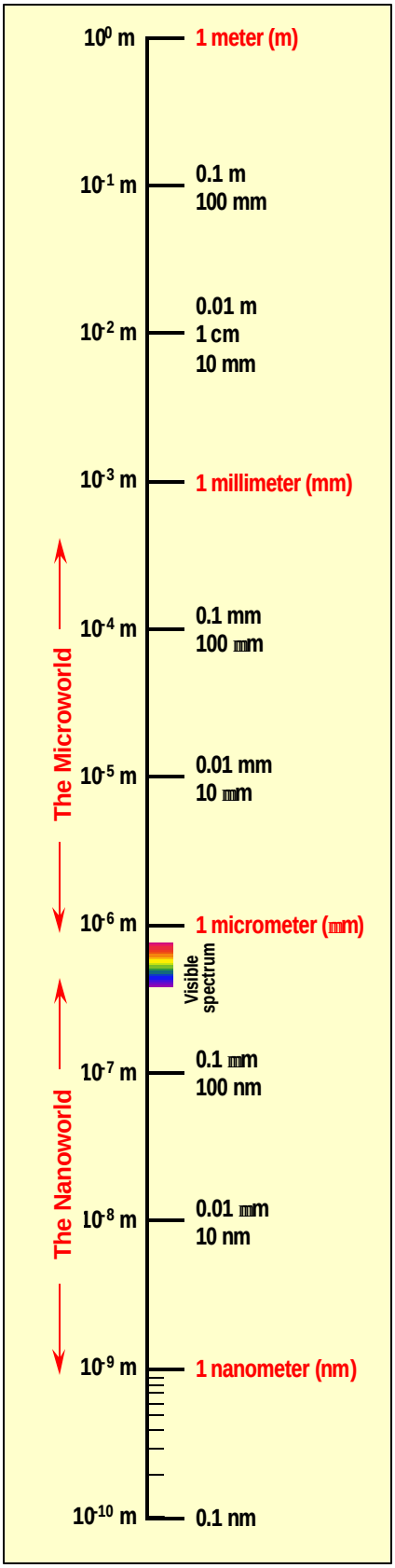


DNA
~2 nm wide



Atoms of silicon
spacing ~tenths of nm

Progress in atomic-level understanding

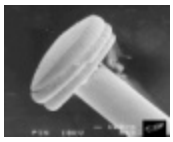


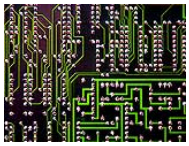
Things Manmade

Progress in miniaturization

Objects fashioned from
metals, ceramics, glasses, polymers ...

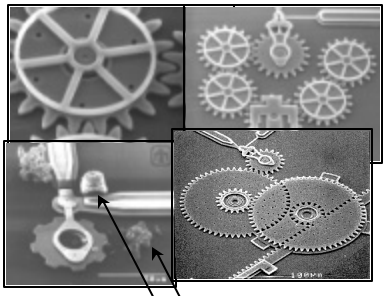
Head of a pin
1-2 mm



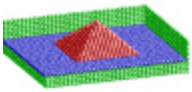


Microelectronics

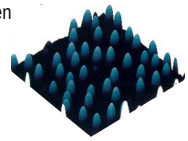
MEMS (MicroElectroMechanical Systems) Devices
10 -100 µm wide



Red blood cells
Pollen

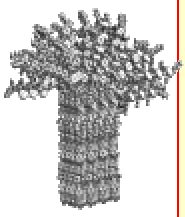


Indium arsenide
quantum dot

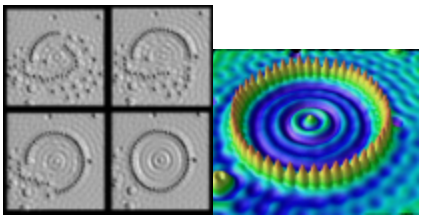


Quantum dot array --
germanium dots on silicon

Biomotor using ATP



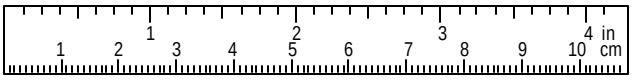
Self-assembled
"mushroom"



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

The 21st century challenge -- Fashion materials at the nanoscale with desired properties and functionality

meter	m	10^0	1 m
centimeter	cm	10^{-2}	0.01 m
millimeter	mm	10^{-3}	0.001 m
micrometer	µm	10^{-6}	0.000001 m
nanometer	nm	10^{-9}	0.000000001 m



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