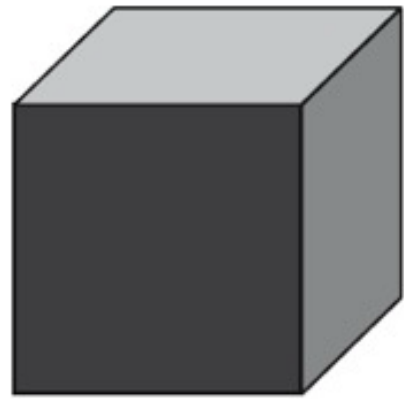


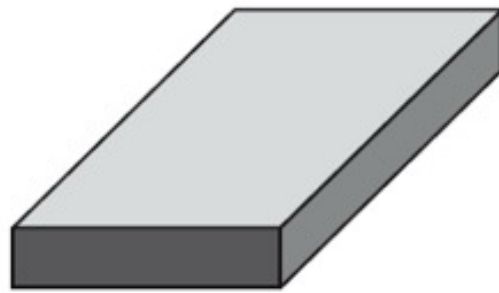
# Nanomaterials:

↳ materials that have one dimension on nano-scale.

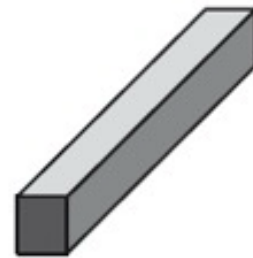
↳ Grain size of 1-100nm



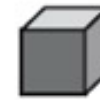
3D  
(bulk)



2D  
(quantum well)



1D  
(quantum wire)



0D  
(quantum dot)

## Classification:

0D  
Nanospheres  
clusters

1D  
Nanotubes,  
wires, rods

2D  
Thin films,  
plates

3D  
Bulk NMs,  
polycrystals

Quantum dots (QD) → Tiny particles  
↳ Diameter 2-10 nm

## Difference b/w macro & nano:

- Volume to surface area ratio:

↳ As objects get smaller V To SA ratio increases

How much surface area is increased (exposed) when a cube of  $1 \text{ cm}^3$  is broken down into cubes (particles) of  $1 \text{ nm}^3$ ?

Original cube:

$$A = 6 \text{ cm}^2$$

$$V = 1 \text{ cm}^3$$

Smaller cube:

$$A = 6 \text{ mm}^2$$

$$V = 1 \text{ nm}^3$$

Volume ratio:  $\frac{1\text{cm}^3}{1\text{nm}^3}$   
 $10^{18}$

## Physical properties:

- Nano materials have discrete electronic states
- Band structure changes, modifying its optical transport properties.

eg:

- Wings of blue morpho butterfly
- Chalk
- Viruses