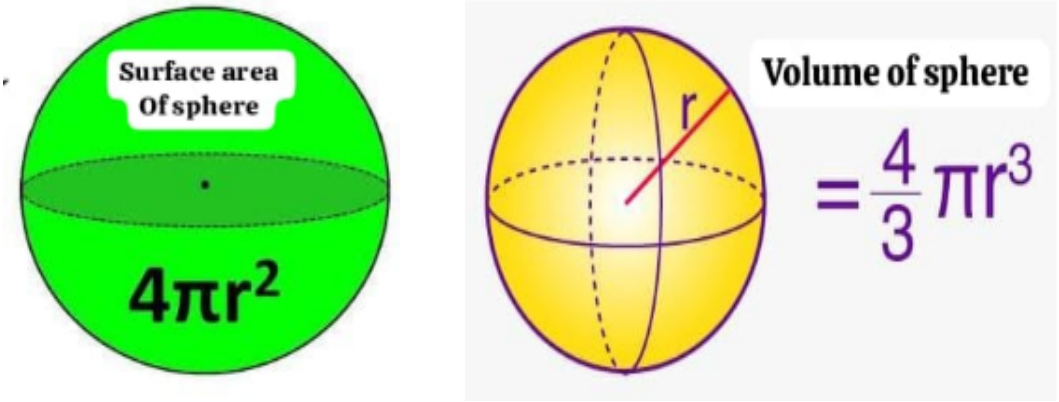
CONCEPT OF NANOMATERIALS - SURFACE AREA TO VOLUME

CONCEPT OF NANOMATERIALS

- The word "nano" is derived from the Greek word "nanos," which means extremely small and refers to a billionth part of a unit. Nanomaterials are materials with at least one external dimension in the range of 1 to 100 nm, and are known as nanomaterials.
- **Examples:**
- Fingernails grow approximately one nanometer every second.
- A sheet of paper is about 100,000 nanometers thick.

SURFACE AREA TO VOLUME RATIO

- **Introduction:**
- When a material or object is reduced to the nanoscale, it exhibits different properties compared to the same material in bulk form. One of the main factors that differentiate nanomaterials from bulk materials is Surface area to volume ratio
- **Definition:**
- The ratio of the surface area of an object to its volume is known as the surface area to volume ratio.
- Nanomaterials have a much larger surface area to volume ratio compared to bulk materials. This property is a key factor for the efficiency of nanotechnology applications.
- **Example 1**: **Sphere**
- Let us consider a sphere with radius *r*

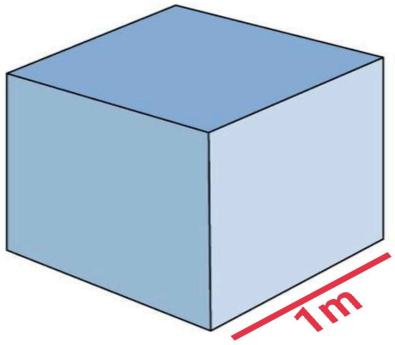


- Surface Area of Sphere (SA) = $4\pi r^2$
- Volume of Sphere (V) = $4\pi r^3 /3$
- Now, Surface Area to Volume ratio= $4\pi r^2 / (4\pi r^3 /3)$

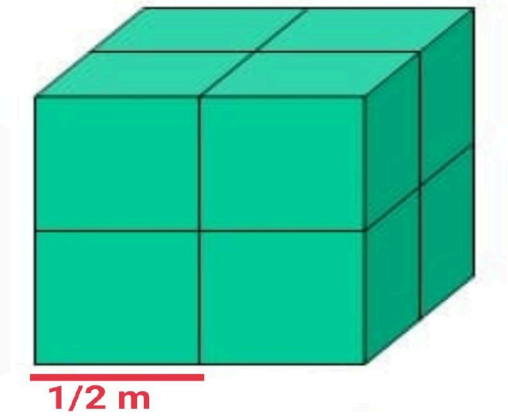
$$= 4\pi r^2 \times (3/4\pi r^3)$$

$$\mathbf{SA/V = 3/r} \text{ .....(1)}$$

- Therefore, the surface area to volume ratio of the sphere depends on its radius and it is increased by decreasing its radius.
- **Example 1**: **Cube**
- Let us consider a cube with a side **a=1m.**



- Surface area of cube = $6a^2 = 6$ **m^2**
- Volume of cube= $a^3 = 1^3 = 1\ m^3$
- **SA/ V of cube = $6a^2/a^3 = 6/a = 6/1 = 6\ m^{-1}$**
- When the cube is divided into 8 smaller cubes, then its side becomes, a=1/2



- **SA/ V of cube = $6/a = 6/(1/2) = 6x2 = 12\ m^{-1}$**
- Therefore, Nanomaterials have a much **larger surface area to volume ratio** compared to bulk.