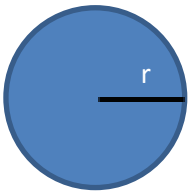
A nanometre is one billionth of a metre (0.000 000 001 m). So, it may not come as a surprise that nanoparticles of material show different properties compared to larger particles of the same material.

The surface area to volume ratio for a material or substance made of nanoparticles has a significant effect on the properties of the material. Firstly, materials made up of nanoparticles have a relative larger surface area when compared to the same volume of material made up of bigger particles.



For example, let us consider a sphere of radius r

The surface area of the sphere will be $4\pi r^2$

The volume of the sphere = $4/3\pi r^3$

Therefore the surface area to the volume ratio will be $4\pi r^2/(4/3\pi r^3) = 3/r$

It means that the surface area to volume ratio increases as the radius of the sphere decreases and vice versa. It also means that when a given volume of material is made up of smaller particles, the surface area of the material increases. Therefore, as particle size decreases, a greater proportion of the particles are found at the surface of the material. For example, a particle of size 3 nm has 50% of its particles on the surface; at 10 nm, 20% of its particles are on the surface; and at 30 nm, 5% of its particles are on the surface. Therefore, materials made of nanoparticles have a much greater surface area per unit volume ratio compared with the materials made up of bigger particles. This leads to nanoparticles being more chemically reactive. As chemical reactions occur between particles that are on the surface, a given mass of nanomaterial will be much more reactive than the same mass of material made up of large particles. This means that materials that are inert in their bulk form are reactive when produced in their nanoparticle form.

A good way to get the idea across is to make use of some model spheres. Ask the students to try and compare the relative volumes and surface area.