



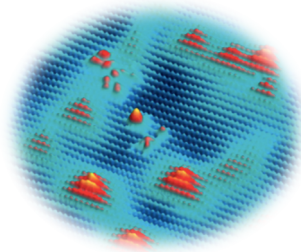
Chemistry or Biology... Dimensional considerations to distinguish these 2 sciences

Letters to replace powers of 10

T	G	M	K	h	da		d	c	m	μ	n	p	f
tera	giga	mega	kilo	hecto	déca		déci	centi	milli	micro	nano	pico	femto
10^{12}	10^9	10^6	10^3	10^2	10^1		10^{-1}	10^{-2}	10^{-3}	10^{-6}	10^{-9}	10^{-12}	10^{-15}

Radius of an atom

The size of an atom is so small that it can only be seen using very specific and expensive microscopes, such as the scanning tunneling microscope.



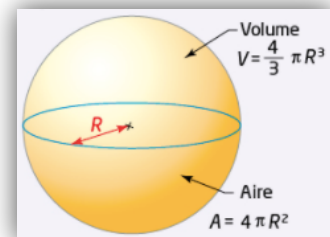
Despite this, we can estimate the order of magnitude of an atom's radius using equipment as basic as a scale and a graduated cylinder.

Some information:

- Mass of a copper atom: $m_{\text{Cu}} = 1.1 \times 10^{-25}$ kg
- An atom can be represented as a sphere of radius R

Equipment:

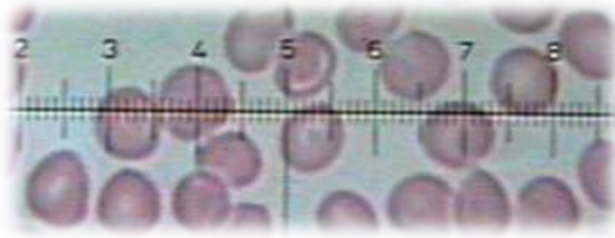
- 1 copper cylinder
- 1 scale
- 1 measuring cylinder



Using the equipment provided, propose and implement a strategy to get an estimate of the radius of a copper atom.



Radius of a cell



red blood cells (X100 lens)

Can you estimate the radius of a cell?

Some information:

- At this magnification, one arbitrary unit (AU) on the micrometer eyepiece corresponds to $10\ \mu\text{m}$.

Conclusion

Atoms are studied by a chemist, while cells are studied by biologists. How do these measurements explain the title of this activity?

And what about molecules?

« At length at Clapham where there is, on the common, a large pond, which I observed to be one day very rough with the wind, I fetched out a cruet of oil, and dropped a little of it on the water. I saw it spread itself with surprising swiftness upon the surface. The oil, though not more than a teaspoonful, produced an instant calm over a space several yards square, which spread amazingly and extend itself gradually until it reached the leaside, making all that quarter of the pond, perhaps half an acre, as smooth as a looking glass.»



Clapham pond before a drop of oil is added

Clapham pond after a drop of oil is added

With these words, Benjamin Franklin describes an experiment he carried out in 1762, while in England. It wasn't until over a century later, in 1890, that Lord Rayleigh repeated this experiment to determine the thickness of the oil film and deduce an order of magnitude for the length of an olein molecule, a constituent of oil.

Would you be able to come up with an estimate of the length of an olein molecule and tell if it concerns mainly chemistry or biology?

BE CAREFUL WITH CONVERSIONS

Some information:

- 1 teaspoon (tsp) = 4.93 mL
- $1\ \text{m}^3 = 10^3\ \text{L}$
- 1 acre (ac) = 43560 square feet (ft^2)
- $1\ \text{ft}^2 = 1\ \text{ft} \times 1\ \text{ft}$
- $1\ \text{ft} = 30,48\ \text{cm}$