

## How big is the nanoscale?






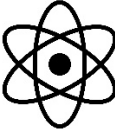

**Education in Chemistry**

January 2018

[rsc.li/EiC118-preciouswater](http://rsc.li/EiC118-preciouswater)

These exercises accompany the above article 'Precious Water'.

**Exercise 1:** Draw lines to match up the measurement described with the appropriate value and unit.

 Height of an average sized horse		20 metres
 <small>Redline/vector/Shutterstock.com</small> Width of an E string on an acoustic guitar		231 pm
 Width of a strand of DNA		0.254 mm
 Height of a Scots pine tree		16 hands
 Average height of an adult female		100 microns
 Atomic radius of calcium		2.5 nanometres
 <small>t work/Shutterstock.com</small> Thickness of a piece of paper		160 cm

**Exercise 2:** Skim read the article 'Precious water'. Below are six sentences showing some figures given in the article. Complete the sentences to give a full account of what the figure is describing. The first one is done for you.

Eg, 416,000 ..... *km of mains water pipes in the UK...*

a. 5–100nm.....

b. 18,000.....

c. 5 ..... a day, .....

d. 150–200.....

e. 40,000–50,000..... during .....in 2016.






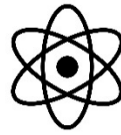

f. 1–5.....

**Exercise 3:** Below is a table with the measurements considered earlier. The measurements have been converted into metres and into nanometres in the first two rows. Complete the rest of the table.

To convert between metres and nanometres you will need to become familiar with the  $\times 10^x$  button on your calculator, and your calculator will convert the answer to standard form for you. If you get stuck with this, get your teacher to show you how to use your calculator to do these conversions.

When converting m to nm you can add  $\times 10^9$  to any figure in m.

When converting nm to m you can add  $\times 10^{-9}$  to any figure in nm.

	Measurement	In metres	In nm
	16 hands	1.63	$1.63 \times 10^9$
 <small>RedlineVector/Shutterstock.com</small>	0.254mm	0.000254	
	2.5nm	$2.5 \times 10^{-9}$	2.5
	20m		
	160cm		$1.6 \times 10^9$
	231pm	$2.31 \times 10^{-10}$	
 <small>Art work/Shutterstock.com</small>	100microns	$1 \times 10^{-4}$	


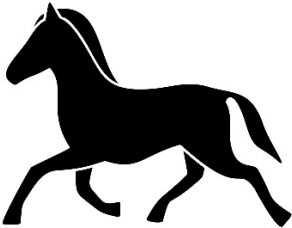


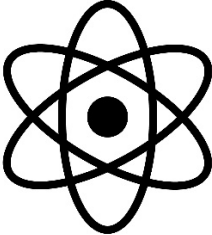


#### **Exercise 4: Considering relative size**

You will need: a pack of icon cards and a roll of toilet paper.

1. Roll out the toilet paper so you have 12 sheets in total.
2. Mark up each sheet with a power of ten scale in nanometres,  $\times 10^1$  nm,  $\times 10^2$  nm etc.
3. Place each icon card in the right place on your toilet paper scale.

Use reference materials (books, the internet) to find out the measurements of some things you consider very small. Convert these measurements to nanometres and put the cards on the scale.

Icon cards for exercise 4

	 <p>Average height of an adult female</p>
 <p>Height of an average sized horse</p>	 <p>Width of an E string on an acoustic guitar</p>
 <p>Width of a strand of DNA</p>	 <p>Atomic radius of calcium</p>
 <p>Height of a Scots pine tree</p>	 <p>Thickness of a piece of paper</p>