Coronavirus at molecular level [14–16]

Education in Chemistry
May 2020
rsc.li/3bGoXdG

This activity looks at the structure of the SARS-CoV-2 coronavirus on a molecular level.

1. The article states that *SARS-CoV-2 is just 50-200 nanometres across, many times smaller than a red blood cell or a grain of pollen*.

   a. Complete **Table 1** by expressing each unit in metres in both decimal and standard form:

Unit	**Name**	**Equivalent in metres**	
		In decimal form	**In standard form**
1 cm	centimetre	0.01 m	1×10^{-2} m
1 mm	millimetre		
1 µm	micrometre		
1 nm	nanometre		

Table 1

   b. A grain of pollen is approximately 50 µm or 50 000 nm in diameter. This means a SARS-CoV-2 virion is approximately 500 times smaller than a grain of pollen.

   A human red blood cell is approximately 9 µm in diameter.

   i. State the diameter of a human red blood cell in nanometres.

   ii. If we take the diameter of a SARS-CoV-2 virion to be 100 nm how many times smaller is SARS-CoV-2 compared to a human red blood cell?

2. Below is a description of a single SARS-CoV-2 virion:

   Each SARS-CoV-2 virion is a spherical particle with surface projections or spikes. Each has four structural proteins known as the spike (S), envelope (E), membrane (M) and nucleocapsid (N) proteins.

   The nucleocapsid protein holds the RNA genome in the centre of the virion. Surrounding the nucleocapsid is a viral envelope. This consists of a lipid bilayer where the membrane, envelope and spike proteins are anchored.

   The spike protein is the protein responsible for allowing the virus to attach to and fuse with the membrane host cell.

   Use the description to add the following labels to the diagram of a SARS-CoV-2 virion shown in **Figure 1**.

   spike protein **envelope protein** **nucleocapsid protein**

   RNA genome **lipid bilayer**

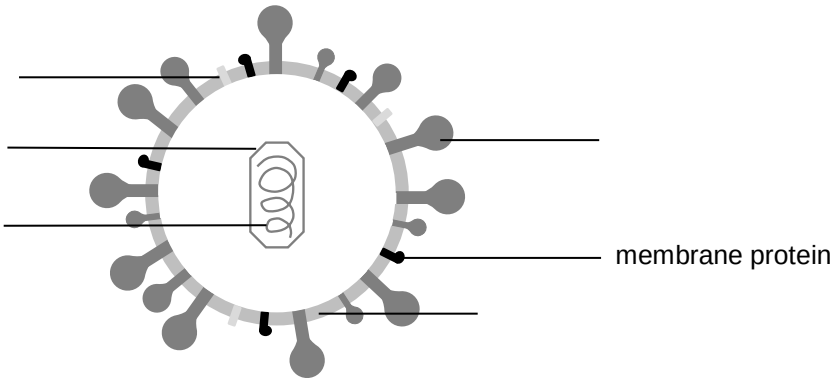
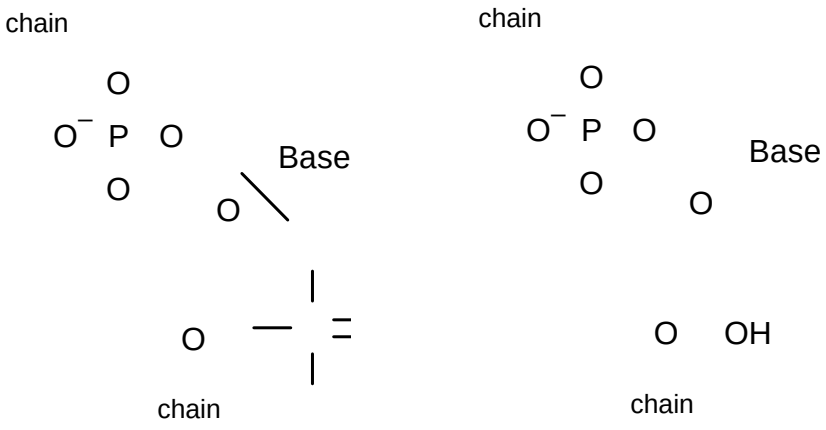


Figure 1

3. The SARS-CoV-2 is an RNA virus. It uses single stranded RNA as its genetic material.
   Viruses can also be DNA viruses.
   Compare the structures of RNA and DNA shown in **Figure 2**.
   Describe how they are different.



DNA

Base = A, C, G and T

RNA

Base = A, C, G and U

where A = adenine, C = cytosine, G = guanine, T = thymine and U = uracil

Figure 2

Answers

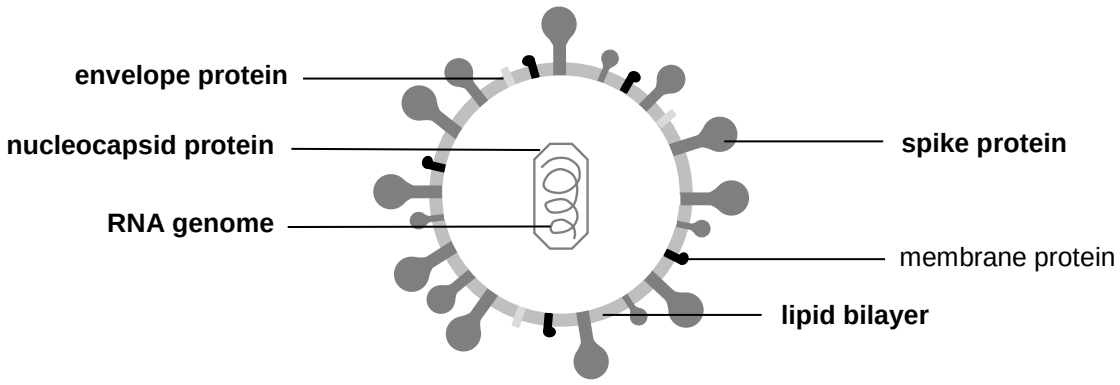
1. a.

Unit	Name	Equivalent in metres	
		In decimal form	**In standard form**
1 cm	centimetre	0.01 m	1×10^{-2} m
1 mm	millimetre	**0.001 m**	**1×10^{-3} m**
1 µm	micrometre	**0.000 001 m**	**1×10^{-6} m**
1 nm	nanometre	**0.000 000 001 m**	**1×10^{-9} m**

b. i. 1 µm = 1 000 nm so 9 µm = **9 000 nm**

ii. 9 000 nm ÷ 100 nm = **90 times smaller**

2.



3. Differences include;
   - Thymine is one of the four possible nitrogenous bases in DNA. In RNA is it replaced by uracil.
   - RNA has an extra hydroxy group (OH) on the five membered pentose ring.