# Coronavirus at molecular level [14–16]

***Education in Chemistry***May 2020
[rsc.li/3bGoXdG](https://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**



membrane protein

**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.

chain

chain

 

chain

chain

 **DNA RNA**

**Base = A, C, G and T 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.



**spike protein**

**lipid bilayer**

**RNA genome**

**nucleocapsid protein**

**envelope protein**

membrane protein

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.