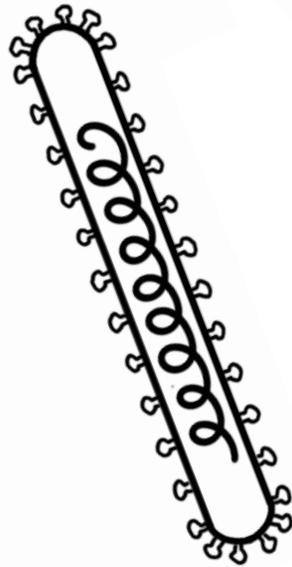
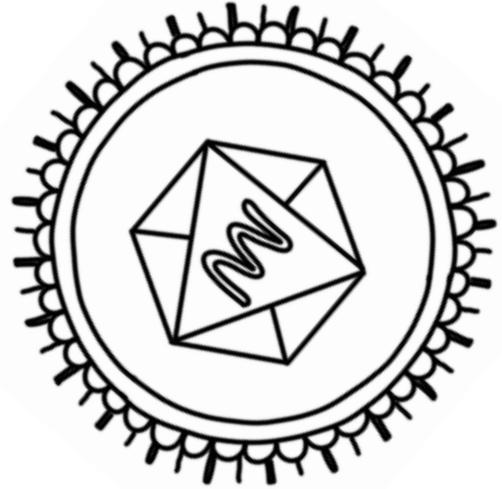
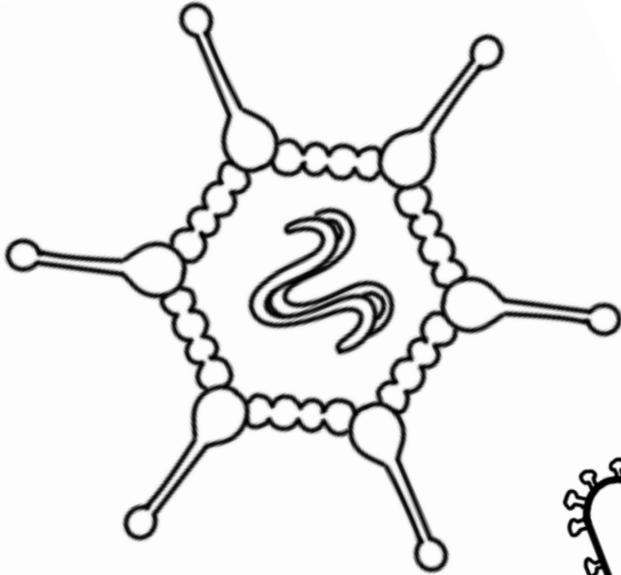


Viruses

Written by Rick Heineman &
Illustrated by Amanda Whispell



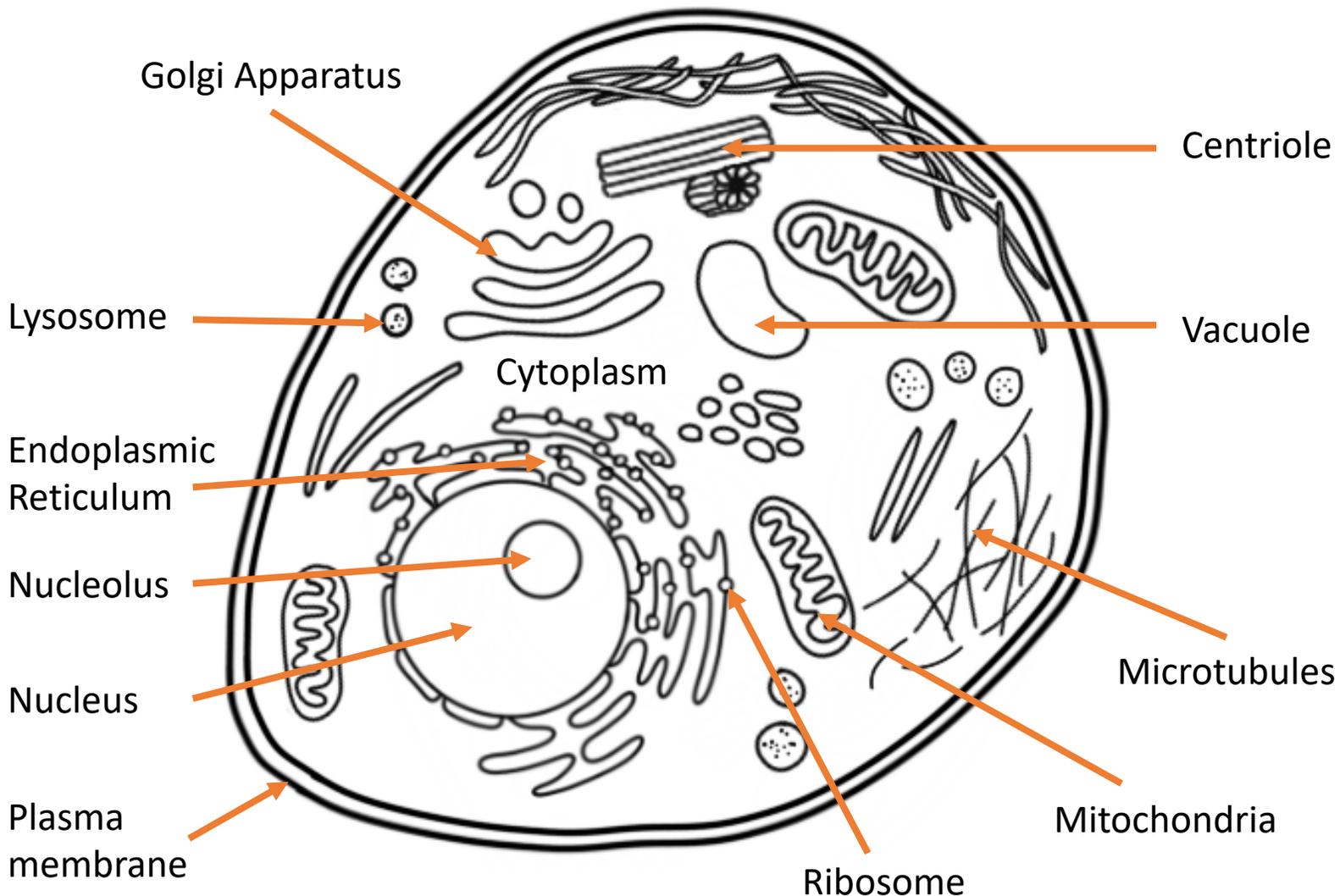
Viruses

What are they??

What do viruses look like? The short answer is that you cannot see a virus because it is too small.

How small is a virus? Let's explore.

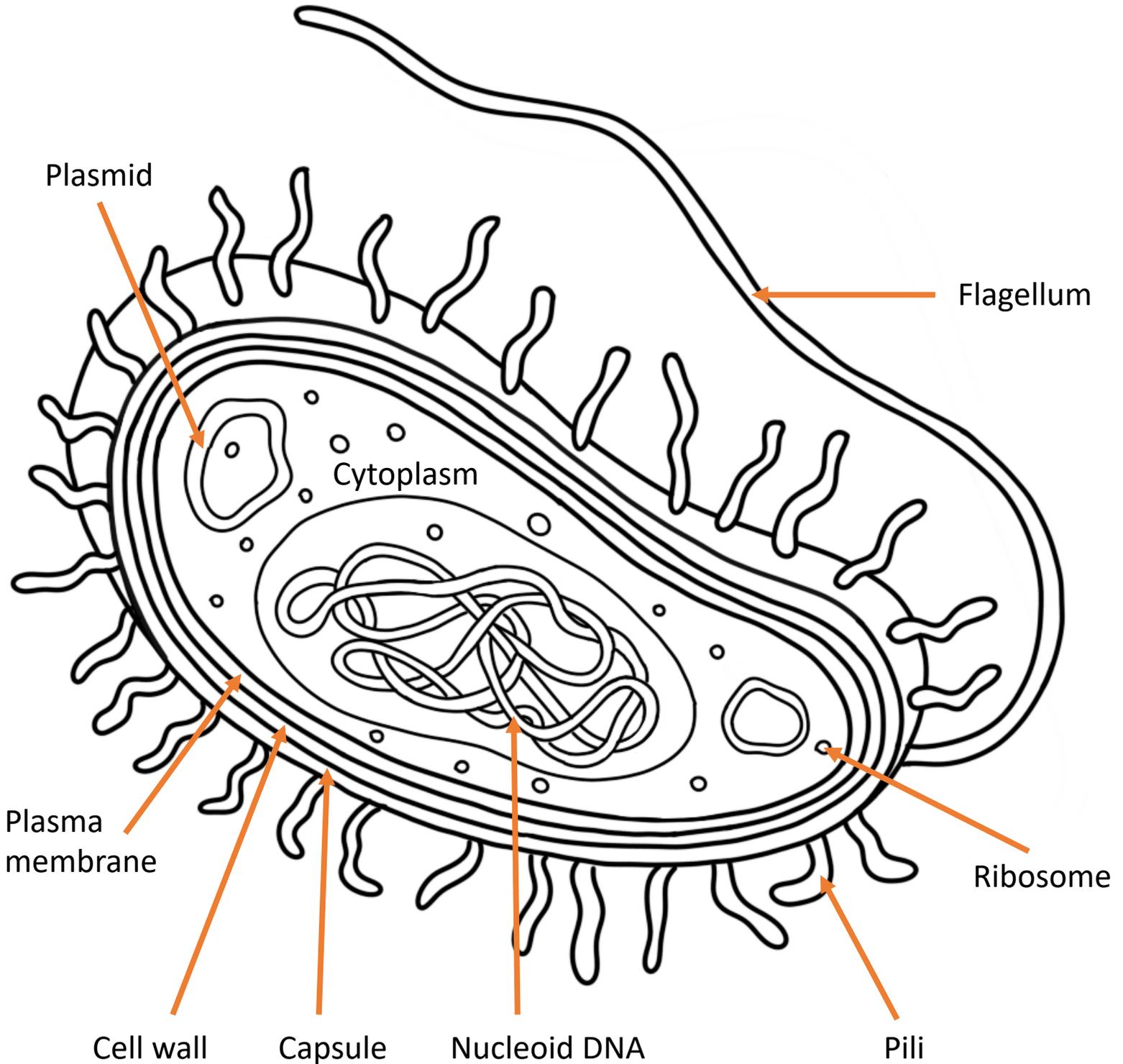
First, here is a typical animal cell (more on cells in coming CoBioArt activities)—the type you have inside of your own body. This is already very small cell. In fact, most are smaller than the width of a human hair! There are some animal cells we can see without a microscope, but most, like this one, are too tiny. Your body is made of about 30 trillion cells.



How much is 30 trillion? A million years has about 30 trillion seconds. So we are made up of a lot of cells.

Animal cells are LARGE compared to bacterial cells though!

Bacteria are all around us – and inside us. Some make us sick, while others keep us healthy and are present in things like yogurt.

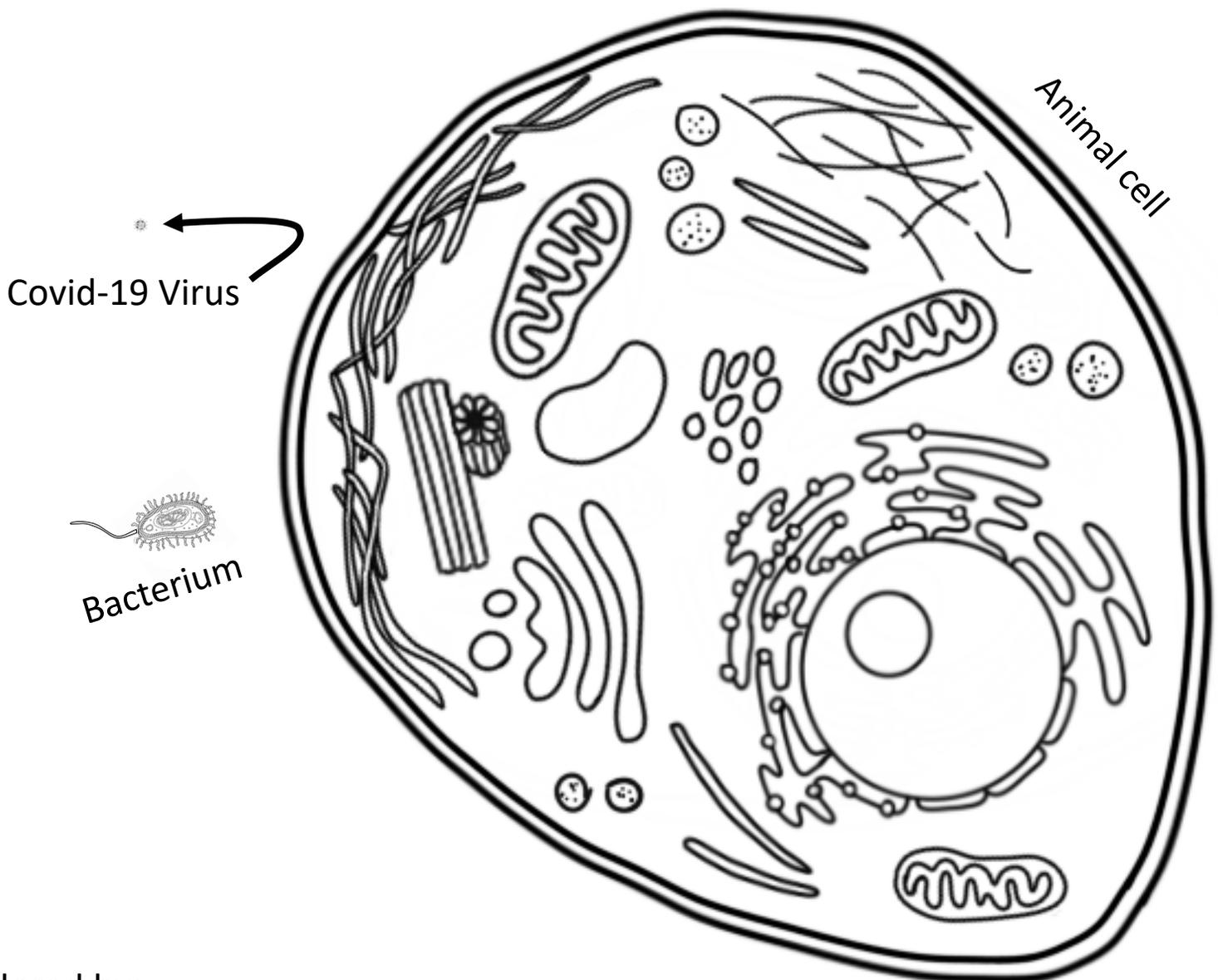


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It is easy to confuse bacteria and viruses. Both can make us sick. They are very different, though.

- Bacteria are cells and can (mostly) live free on their own
- Viruses are not cells, and can only reproduce by getting inside cells and turning them into virus factories
- Viruses are also (mostly) much smaller than bacteria. Most can only be seen with special microscopes that use electrons instead of light to make images
- When bacteria get us sick, antibiotics can often help – but antibiotics don't work on viruses!

Here they are all together so you can see how different they are!

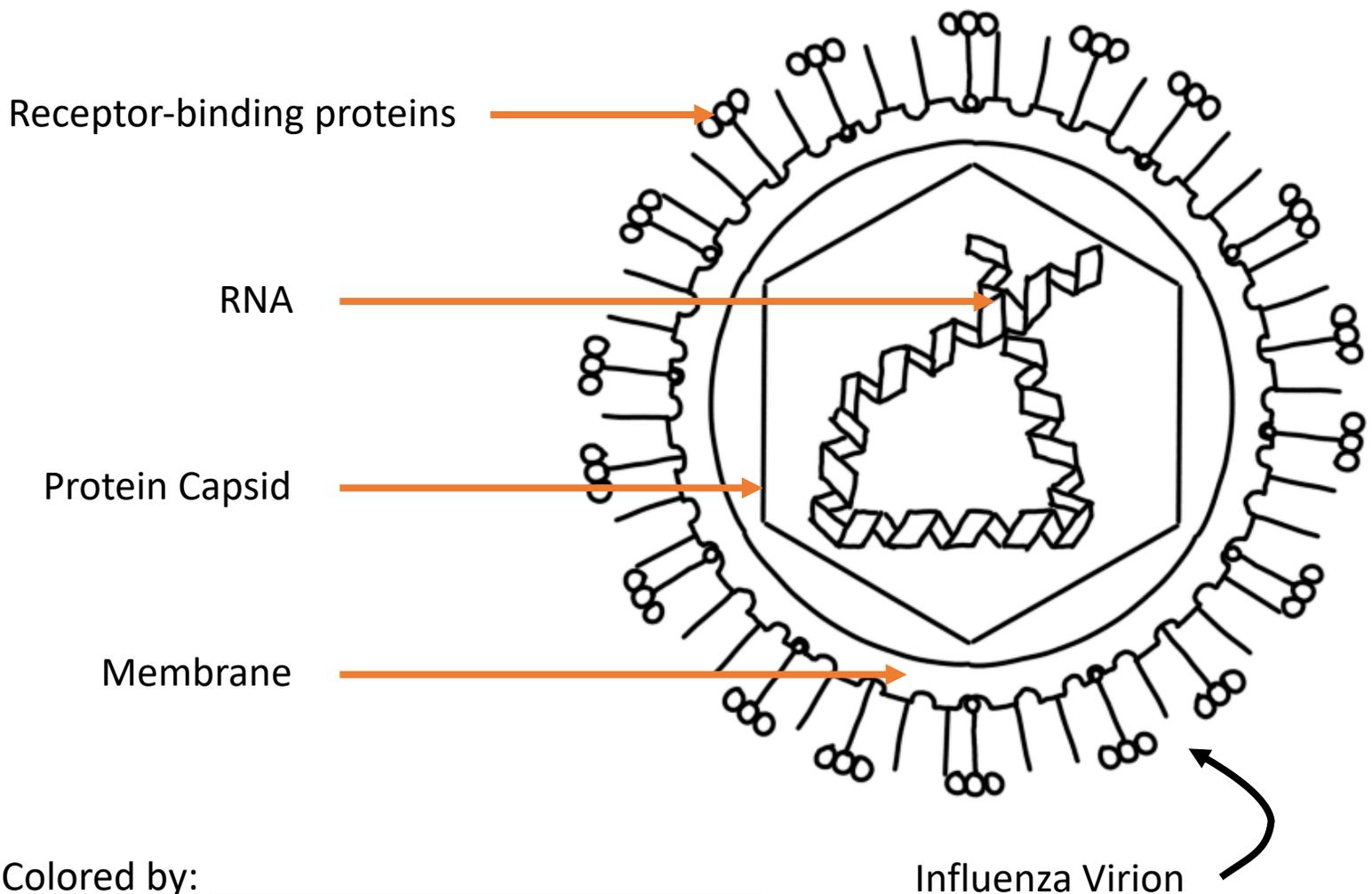


Viruses all have at least two forms:

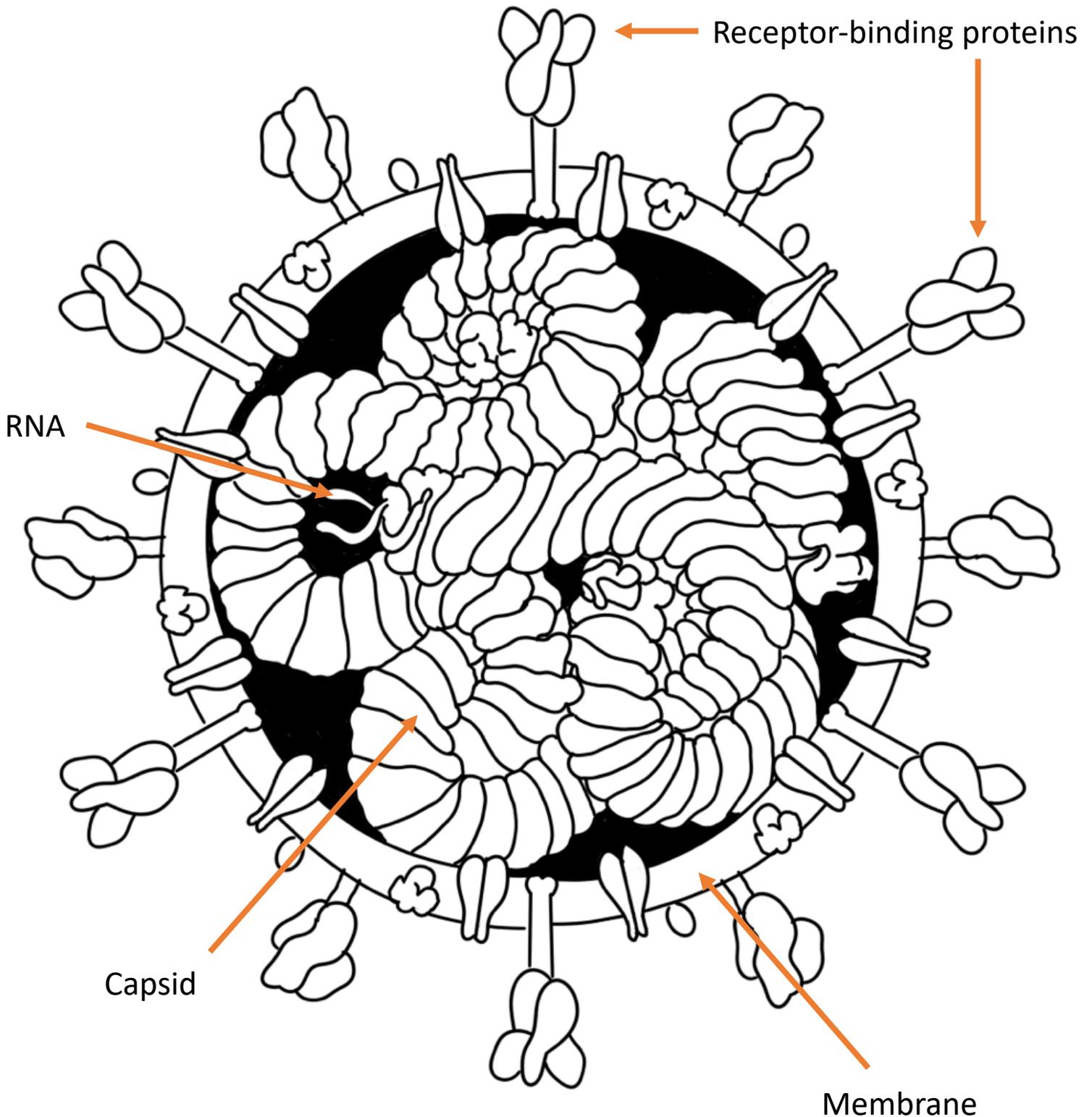
1. In one form, they are inside the cell transforming it into that virus factory
2. The second form (seen below) is what we usually think of when we imagine a virus – it is known as a **virion**. This is the form the virus uses to move from cell to cell. It is like a spacesuit for the virus.

Virions all need to carry instructions that can transform the cell they infect. These instructions, or **genomes**, can be made of **DNA** or **RNA**. Virions also all have a **protein capsid** that covers and protects their genomes.

Finally, all virions need to enter the cells they infect. They do this by sticking to **receptors** on the outside of the cell. All virions use **receptor-binding proteins** on their outside to do this. Many virions have a **membrane** on their outside (our cells also have membranes on the outside). Virions may also carry other proteins that are important right after the virus infects / enters a new cell.

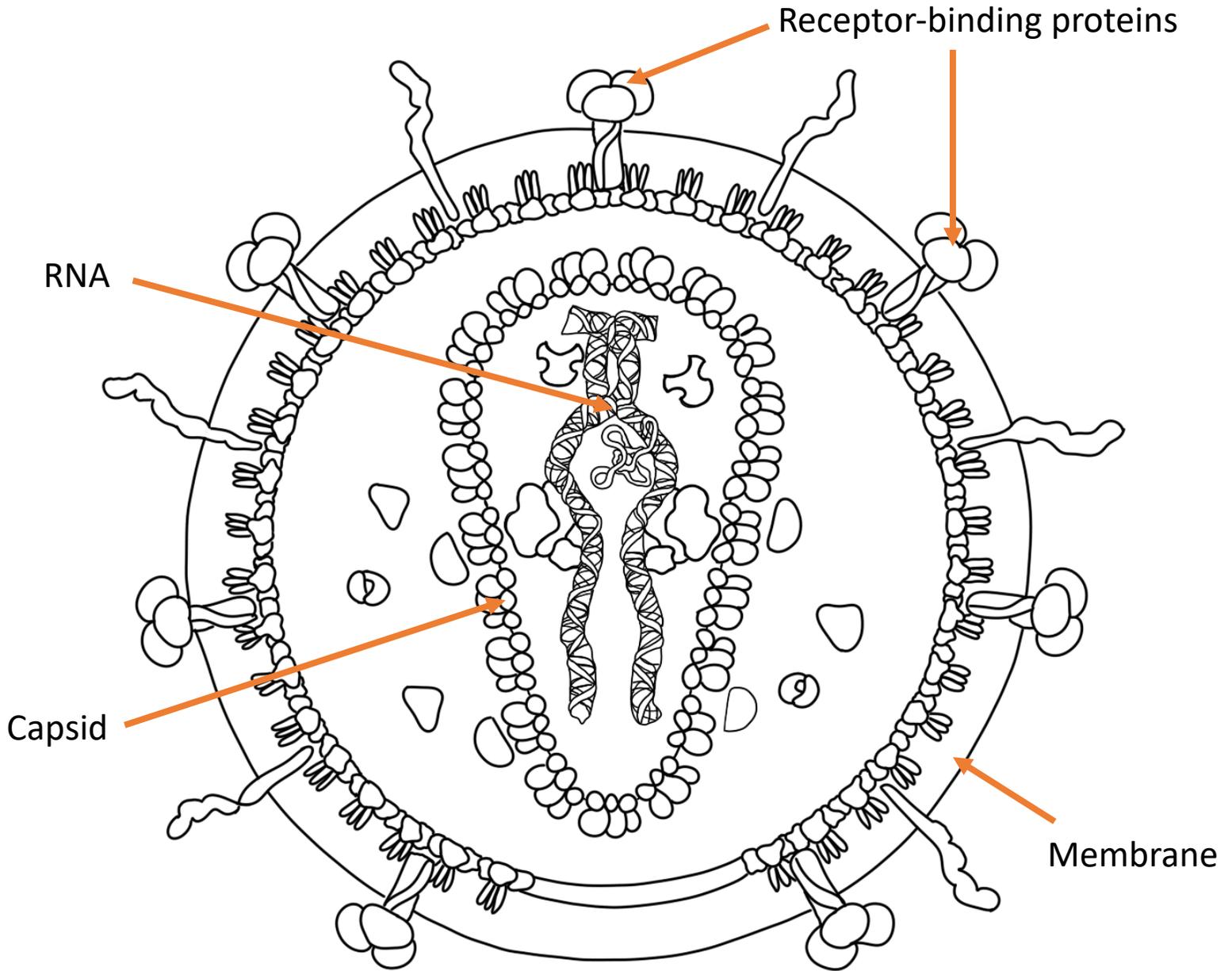


This is **SARS-CoV-2**, the coronavirus that causes the disease **COVID-19**. Like most human viruses, it has a membrane, and receptor-binding proteins that stick out of the membrane. Its genome (instruction manual) is made of RNA.



This is **HIV**, the virus that causes **AIDS**.

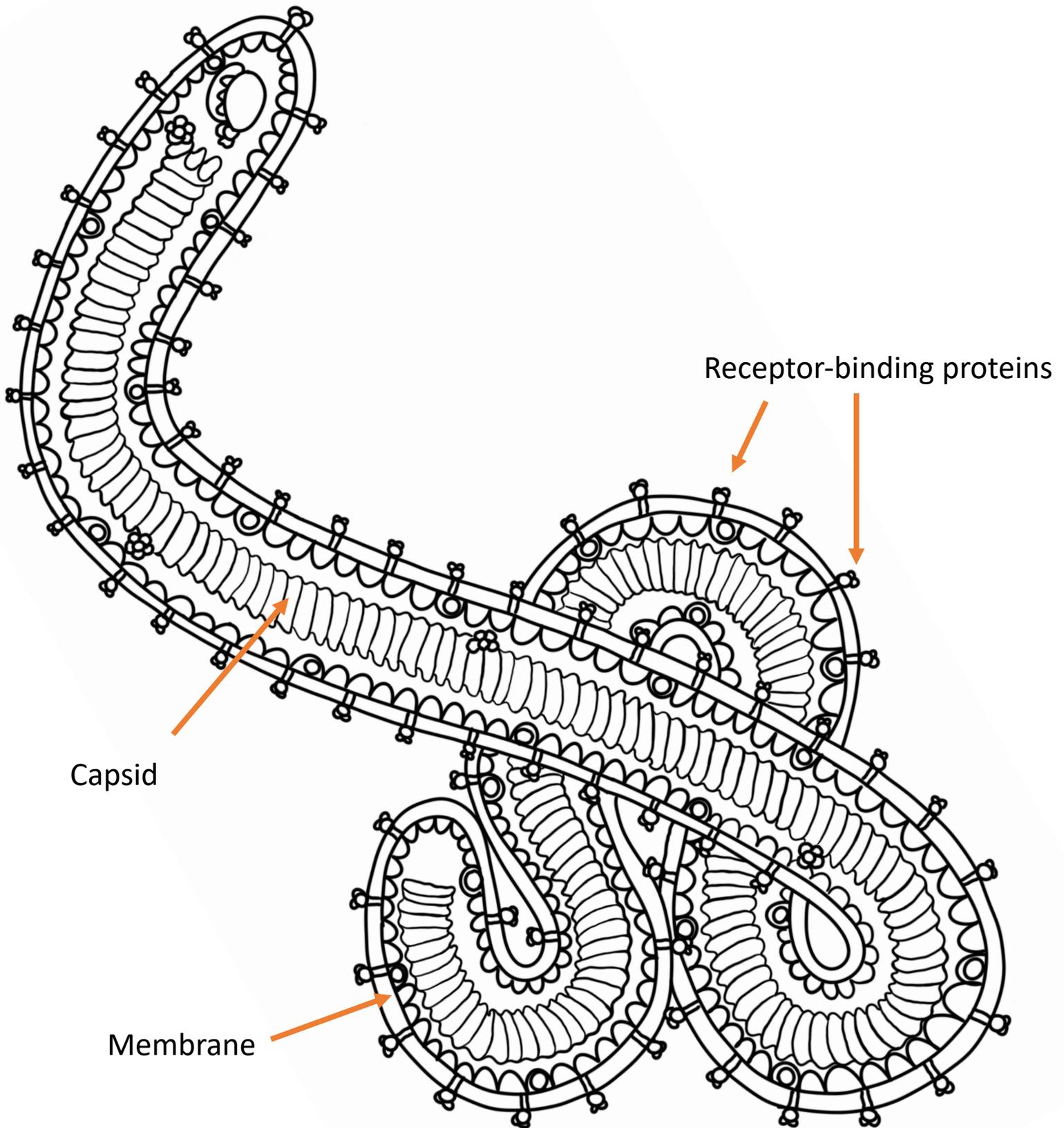
Its genome (instruction manual) is RNA, but it carries a protein that uses the RNA to make DNA, which is something our cells don't usually do.



It also has a membrane and receptor-binding proteins that stick out of the membrane.

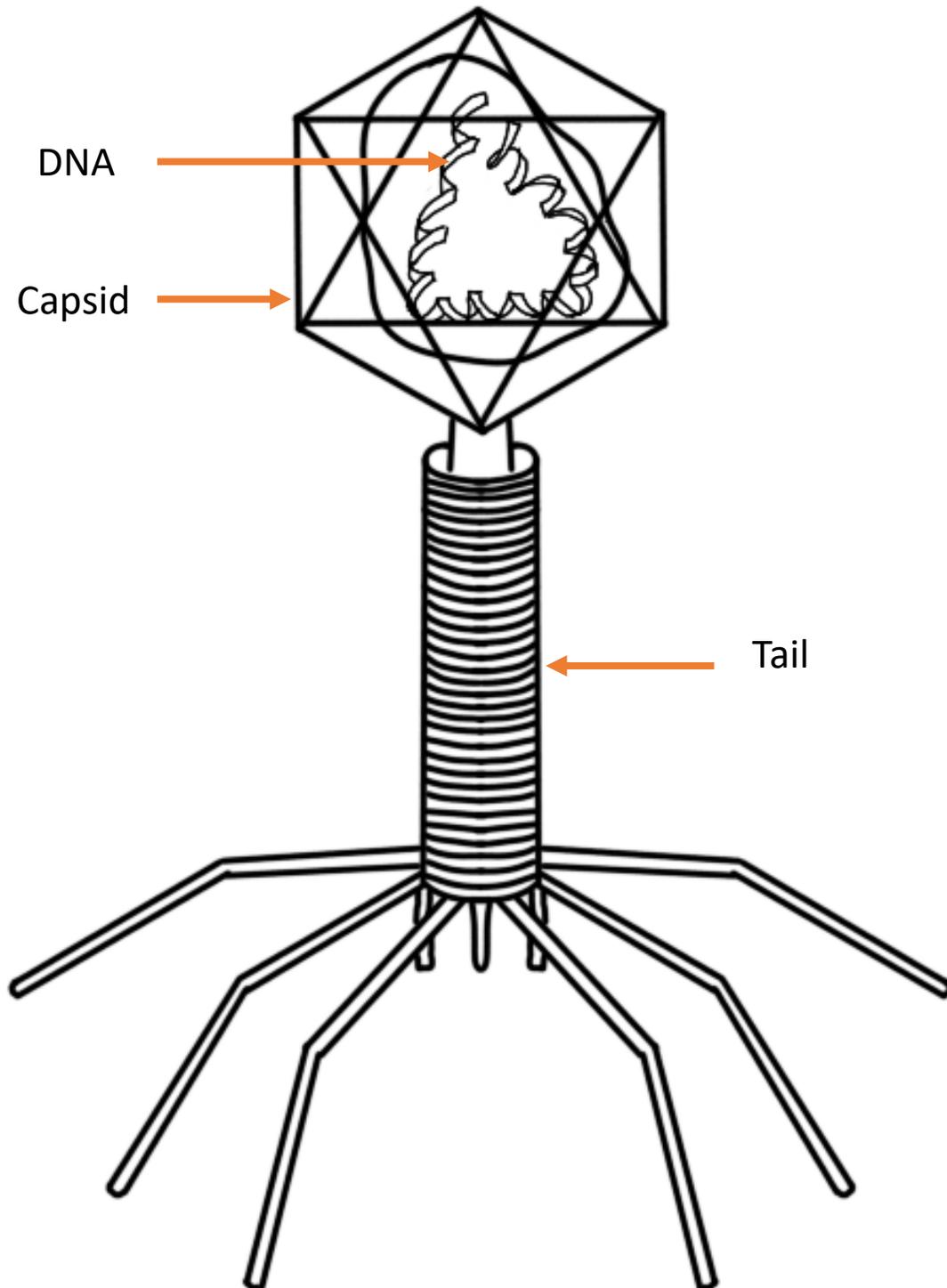
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This is **ebolavirus**, which causes the disease **Ebola**. It has an RNA genome (instruction manual). It is actually much larger than the other viruses shown here!



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This is **bacteriophage T4**. This type of virus doesn't infect us – it infects bacteria! It doesn't have a membrane. Its DNA genome is located in the capsid head on top, and its receptor-binding proteins are the “legs” on the bottom.



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References

As most images of viruses are illustrations we did have to utilize the work of other artists to generate our drawings. Please see the list below for the origin of each original illustration.

1. Sars-CoV-2
 - Thomas Spletstoesser
 - www.scistyle.com
2. HIV Virion
 - 2015 ViralZone
 - <https://viralzone.expasy.org/5182>
3. Ebolavirus
 - 2014 ViralZone
 - <https://viralzone.expasy.org/207>
4. Bacteriophage and Influenza Virion
 - 2018 GoRiki
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5. All other viruses (including cover images)
 - Marina Efremova
 - <https://www.dreamstime.com/stock-illustration-classification-viruses-enveloped-nonenveloped-vector-biology-icons-medical-virus-icons-image68736220>