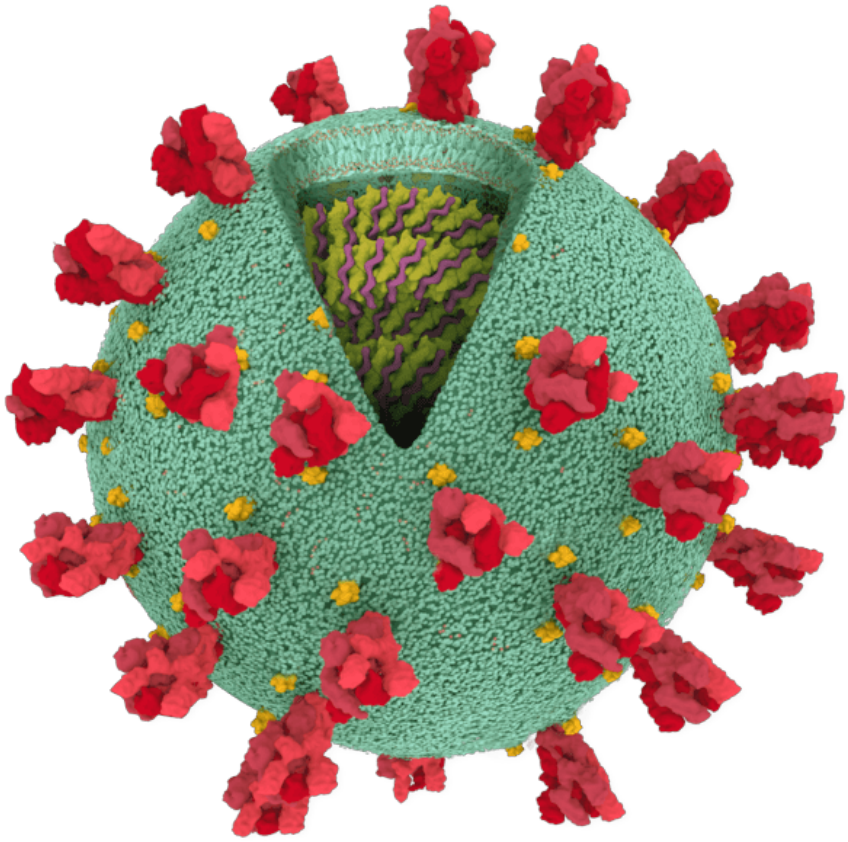
Detail of the genome SARS-CoV-2: Terrorists occupy human lung cells

Basically, these proteins are like a bunch of terrorists coming to take over factories inside the cell. There are proteins that will serve as a watchdog, have proteins that kidnap and threaten hostages, require the factory to obey them, others will disguise to distract the police, and have proteins that can be used.

Virus " *is simply a piece of bad news encapsulated in protein"* , which is the definition that biologists Jean and Peter Medawar wrote in 1977. *The* " *bad news* " they refer to is the data. transmission of viruses, contained in RNA that make up their genome. The RNA is located in the center of the viral particle, and is protected by many layers of proteins.

In January 2020, the scientists finally deciphered the very bad tidbit they received from the end of 2019: the entire genome of the SARS-CoV-2 virus caused the COVID-19 pandemic. This piece of news was passed on to a 41-year-old man working at the Huan Nam Seafood Market in Wuhan, China, one of the first cases of COVID-19 in the world.



Decoding the virus genome is the first step to understanding the disease it causes, how the virus enters the body, multiplies and causes disease. Scientists around the world are still trying to dig into each gene to find the weak spot of SARS-COV-2, where a drug or vaccine could target.

Fortunately, you don't need to be a scientist to follow this process now. The following article will decipher for you all the bad news that humanity has received in 2019. You will also see firsthand the proteins that SARS-CoV-2 is using to invade human cells.

Basically, these proteins are like a bunch of terrorists coming to take over factories inside the cell. There are proteins that will serve as a watchdog, have proteins that kidnap and threaten hostages, require the factory to obey them, others will disguise themselves to distract the police, and have proteins that open their way when they Mission accomplished:

SARS-CoV-2 RNA

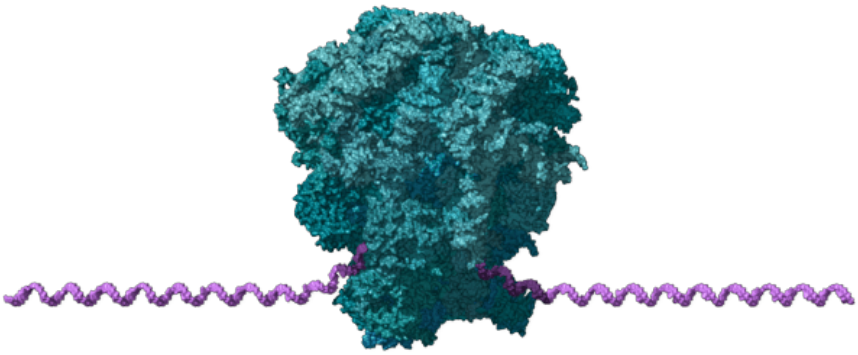
As a virus, SARS-CoV-2 cannot live outside its host. It must take control of our cells to multiply and spread. When SAR-CoV-2 finds a suitable cell, it injects an RNA sequence containing its entire genome into the cell.

The SARS-CoV-2 genome contains about 30,000 characters. (In comparison, our genome contains over 3 billion). The scientists identified the gene encoding up to 29 proteins. Not only do proteins wrap around to protect RNA, they also do a range of tasks from copying copies of viruses, to blocking the immune response of the human body against them.

This is the first sequence of characters in SARS-CoV-2 RNA:

```
auuaaaggguuuauaccuuucccagguaacaaaccaaccaacuuucgaucucuuguagaucuguucucuaa
acgaacuuuaaaaucuguguggcugucacucggcugcaugcuuagugcacucacgcaguauaauuaauua
acuaauuacugucguugacaggacacgaguaacucgucuaucuucugcaggcugcuuacgguuucgucc
guguuugcagccgaucaucagcacaucuaggguuucguccgggugugaccgaaaggguaag
```

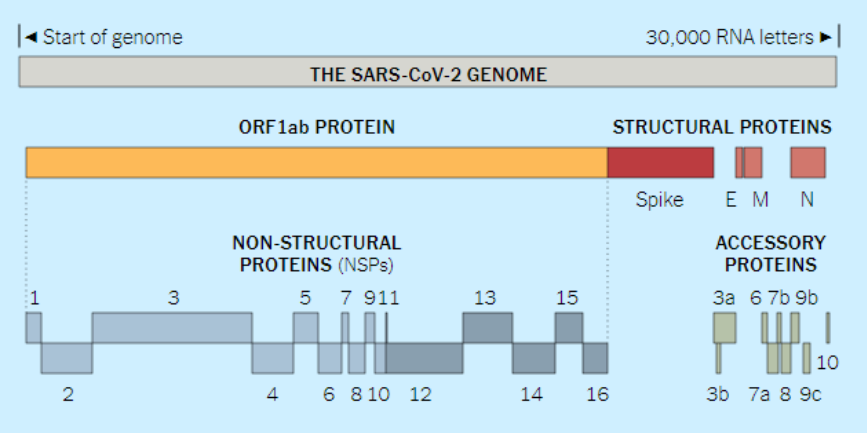
As soon as the virus injects RNA into the cell, this sequence will recruit the organelles - the biosynthetic machinery system in the infected cell - to read the viral RNA characters - including a, c , g and u - and then translate them into viral proteins.



Meaning that the organelles are working to produce proteins for the cells, they are now hypnotized by the first code of SARS-CoV-2 to switch to producing proteins for viruses including:

Protein chain · ORF1ab

The first SARS-CoV-2 viral protein created inside the infected cell is actually a chain of 16 proteins joined together. Two of these proteins act like scissors, cutting the bonds between these proteins and releasing them so they can begin to do their job.



Previous studies of the corona virus family have helped scientists understand what SARS-CoV-2 proteins are doing in human cells. But this virus still has some other more mysterious proteins, and some proteins seem to do nothing.

Protein destroys cells · NSP1

This protein of SARS-CoV-2 is responsible for slowing down the process by which infected organelles produce its own protein. The slowing down will force infected cells to increase the viral protein's production capacity, and prevent cells from assembling anti-virus proteins.

A cell can be understood as a factory with many workshops. SARS-CoV-2, after capturing the first few workshops, will send NSP1 to harass the remaining workshops, including a cell factory producing weapons to fight the virus. Through this harassment, the cell is increasingly turning its factories into producing proteins for viruses, which neglect their own work.

```
auggagagccuugucccuggauucaacgagaaaacacacguccaacucaguuugccuguuuuacagguu
cgcgacgugcucguacguggcuuuggagacuccguggaggaggucuuaucagaggcacgucaacaucuu
aaagauggcacuuguggcuuaguagaagauugaaaaaggcguuuugccucaacuugaacagcccuaugug
uucaucaaacguucggaugcucgaacugcaccucaugucauguuaugguugagcugguagcagaacuc
gaaggcauucaguacggucguaguggugagacacuugguguccuugucccucauguggcgaaauacca
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gaucuaaagucauuugacuuaggcgacgagcuuggcacugauccuuaugaagauuuucaagaaaacugg
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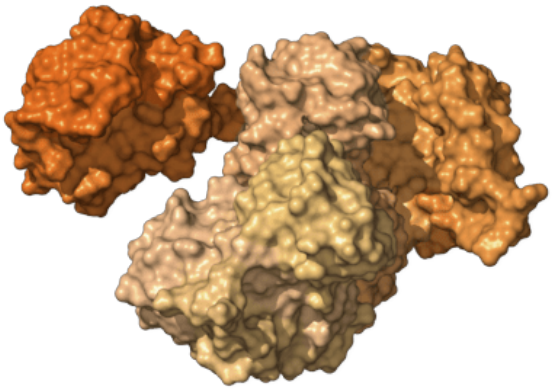
```

Mysterious protein · NSP2



Scientists are not sure what they know what NSP2 does in cells. But the other proteins it attaches can provide some clues. Two of them help move molecules filled with bubbles called endosomes.

gcauacacucgcuaugucgauaacaacuucuguggcccugauggcuacccucuugagugcauuaaagac
cuucuagcacgugcugguaaagcuucaugcacuuuguccgaacaacuggacuuuauugacacuaagagg
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guugguacaccaguuuguauuaacgggcuuauguugcucgaaaucaaagacacagaaaaguacugugcc
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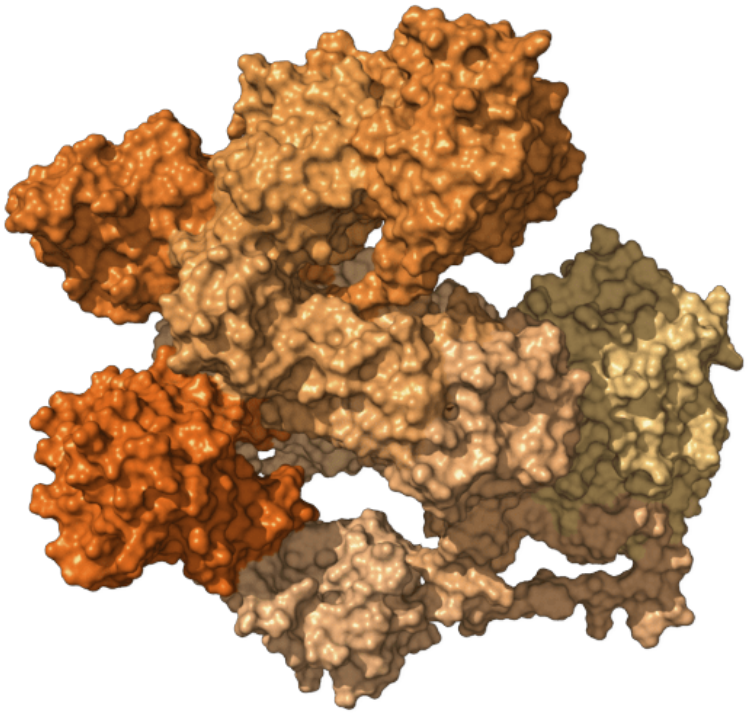
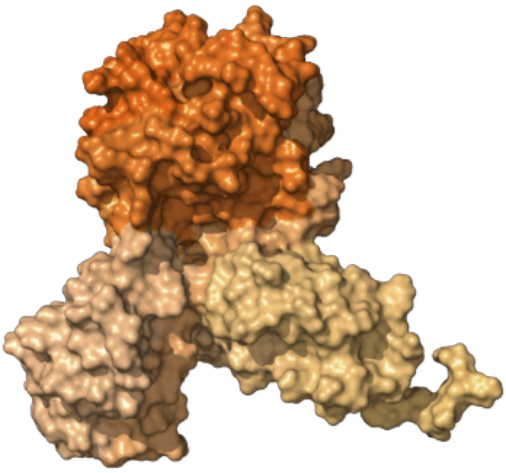
Protein is removed, removed, cut · NSP3



NSP3 is a large protein that undertakes two important tasks. First, it will go to see if any viral proteins are entangled and will cut them apart to go on a mission. Second, it also alters many proteins of the infected cell.

Normally, a healthy cell will regularly filter out its aging proteins, tag them for self-destruction. But the corona virus can remove these tags, thereby causing the infected cell to become unbalanced, weaken it and reduce its ability to develop mechanisms to fight the virus.

Bubble maker · NSP4



Combined with other proteins, NSP4 helps create bubbles filled with fluid in the infected cell. Inside these bubbles is where the virus replica parts are assembled and built.

```
aaaauuguuaauaauuggguugaagcaguuaauuaaaguuacacuuguguuccuuuuuguugcugcuauu
uucuauuuaauaacaccuguucaugucaugucuaaacauacugacuuuucaagugaaaucauaggauac
aaggcuauugauggugguguucacucgugacauagcaucuacagauacuuguuuuugcuaacaaacaugcu
gauuuugacacauggguuuagccagcgugggugguaguuauacuaaugacaaagcuugcccauugauugcu
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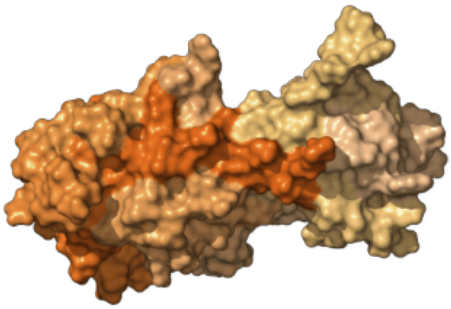
Protein pulling · NSP5



This protein is a pair of scissors that cut the ribbon, releasing other NSP proteins so they can do their own thing.

```
agugguuuuagaaaaauggcauucccaucugguaaaguugaggguuguaugguacaaguaacuuguggu
acaacuacacuuaacggucuuuggcuugaugacguaguuuacuguccaagacaugugaucugcaccucu
gaagacaugcuuaacccuaauuaugaagauuuacucauucguaagucuaaucauaauuucuugguacag
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ucugcucaaacuggaauugccguuuuagauaugugugcuucauuaaaagaauuacugcaaaaugguaug
aauggacguaccauauuggguagugcuuuauuagaagaugaauuuacaccuuuugauguuguuagacaa
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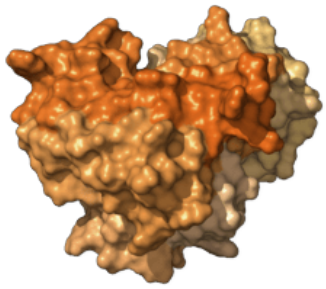
```

Bubble factory · NSP6



This protein works with NSP3 and NSP4 to create viral production bubbles.

```
agugcagugaaaagaacaaucaaggguacacaccacugguuguuacucacaauuuugacuucacuuuua
guuuuaguccagaguacucaauggucuuuguucuuuuuuuuguaugaaaaugccuuuuuaccuuuugcu
auggguauuauugcuaugucugcuuuugcaaugauguuugucaaacauaagcaugcauuucucuguuug
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augaauucacagggacuacucccacccaagaauagcauagaugccuucaaacucaacauuaaauuguug
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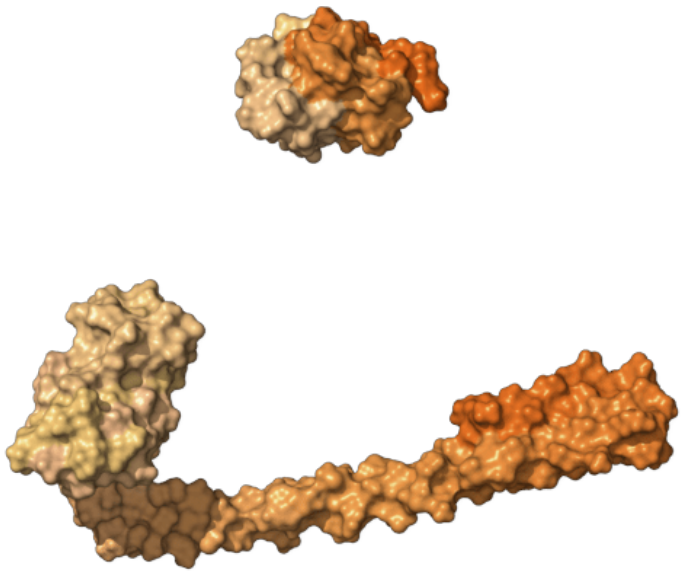
Copy Assistant · NSP7 and NSP8



These two proteins help NSP12 make new copies of the RNA genome, eventually forming new viruses.

```
ucuaaaaugucagauguaaagugcacaucaguagucuuacucucaguuuugcaacaacucagaguagaa
ucaucaucuaaauuguggggcucaaugugucccaguuacacaaugacauucucuuagcuaaagauacuacu
gaagccuuugaaaaaauggguuucacuacuuucuguuuugcuuuccaugcagggugcuguagacauaaac
aagcuuugugaagaaaugcuggacaacagggcaaccuuacaa

gcuauagccucagaguuuaguucccuuccaucauaugcagcuuuugcuacugcucaagaagcuuaugag
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gcagauaguaaaauuguucaacuuagugaaauuaguauggacaauucaccuaauuuagcauggccucuu
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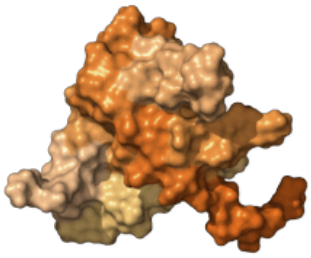
```

Protein takes over the center of the cell · NSP9



This protein enters the small channels in the nucleus of the infected cell, which contains our human genome. It can affect the movement of molecules inside and outside the nucleus - but NSP9 does so for what purpose, no scientist knows.

```
aauaaugagcuuaguccuguugcacuacgacagaugucuugugcugccgguacuacacaaacugcuugc
acugaugacaaugcguuagcuuacuacaacacaacaaagggagguaggguuuguacuugcacuguuaucc
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gaaccaccuuguagguuuguuacagacacaccuaaagguccuaaagugaaguauuuauacuuuauuaaa
ggauuaaacaaccuaaauagagguaugguacuugguaguuuagcugccacaguacgucuacaa
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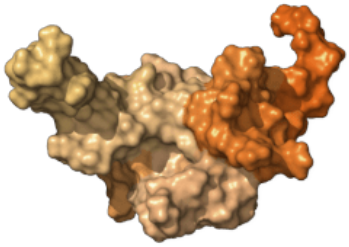
Genetic camouflage protein · NSP10



Human cells have antiviral proteins. These proteins will patrol for viral RNA. Once a viral RNA is found, it will dissolve it. In that context, NSP10 works with NSP16 to disguise the virus genes, preventing them from being attacked.

```
gcugguaaugcaacagaagugccugccaauucaacuguauuaucuuucugugcuuuugcuguagaugcu
gcuaaagcuuacaaagauuaucuagcuaguggggacaaccaaucacuaauuguguuaagauguugugu
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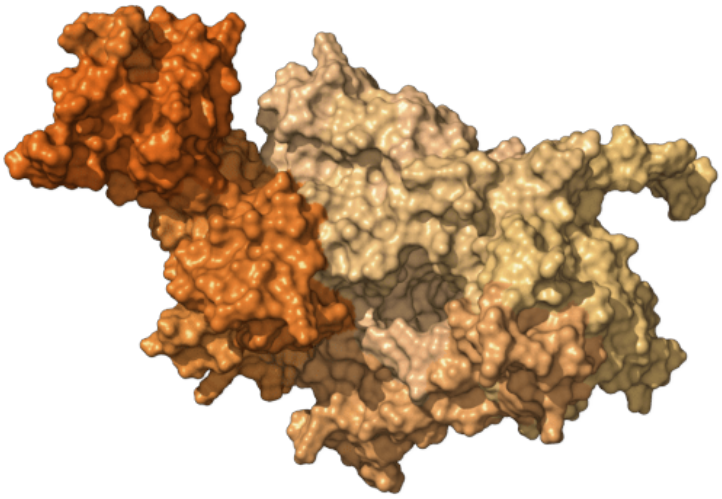
cag
```

Copier · NSP12



This protein aggregates the genetic characters into the genome for the new virus. Researchers have discovered that Remdesivir can interfere with the NSP12 protein of other corona virus strains. Therefore, they are testing to see if this drug can slow down the reproduction of SARS-CoV-2.

When a SARS-CoV-2-infected cell reads the virus's genome, it reads it to NSP12, beginning with the sequence:

```
ucagcugaugcacaaucguuuuuaaac...
```

Then continue with a letter c and continue:

```
. . . cggguuugcgguguaagugcagcccgucuuacaccgugcggcacaggcacuaguacugaugucgua
uacagggcuuuugacaucuacaaugauaaaguagcugguuuugcuaaauuccuaaaaacuaauuguugu
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aaaccagguggaaccucaucaggagaugccacaacugcuuaugcuaauaguguuuuuaacauuugucaa
gcugucacggccaauguuaaugcacuuuuaucuacugaugguaacaaaauugccgauaaguauguccgc
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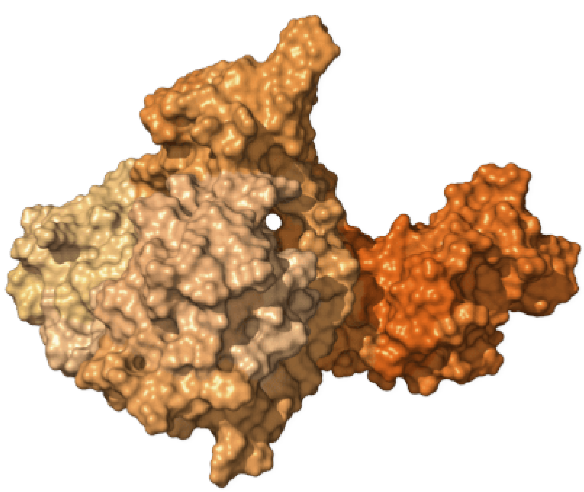
```

Another sequence, NSP11, overlaps with part of RNA. But scientists do not know whether the small protein encoded by this gene has any function.

RNA torsion · NSP13



Normally, viral RNA will wrap into complex helices. The scientists suspect that NSP13 will untangle it so that other proteins can read the RNA sequence and make new copies.

```
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ccguauguuugcaaugcuccaggguugugaugucacagaugugacucaacuuuacuuaggagguaugagc
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ccuucugcucgcauaguguauacagcuugcucucaugccgcuguuugaugcacuaugugagaaggcauua
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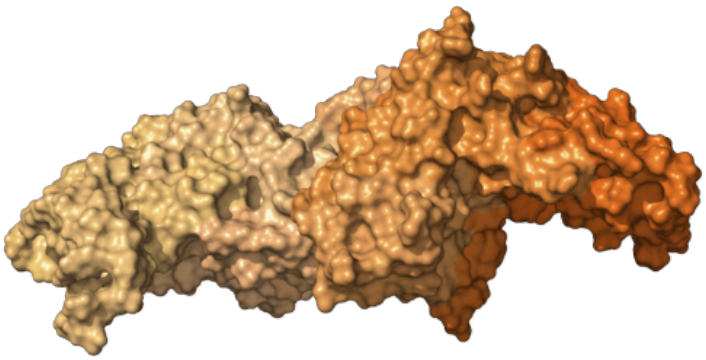
acuuuacaa
```

Spelling checker · NSP14



While NSP12 copies the SARS-CoV-2 genome, it sometimes accidentally adds a wrong character to a new virus copy. NSP14 will eliminate these errors, so that NSP12 continues to add the correct characters.

gcugaaaauguaacaggacucuuuaaagauuguaguaagguaaucacuggguuacauccuacacaggca
ccuacacaccucaguguugacacuaaauucaaaacugaaggguuuauguguugacauaccuggcauaccu
aaggacaugaccuauagaagacucaucucuauga ugggguuuuaaaaugaauuaucaaguuaaugguuac
ccuaacauguuuaucacccgcgaagaagcuauaagacauguacgugcauggauuggcuucgaugucgag
gggugucaugcuacuagagaagcuguuggguaccaauuuaccuuuacagcuagguuuuucuacagguguu
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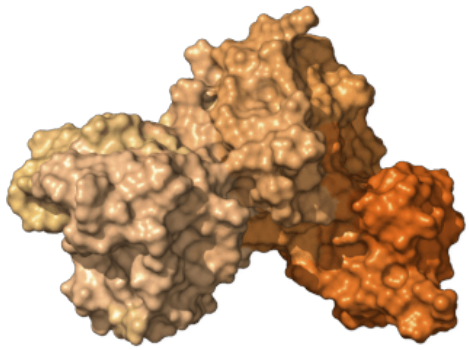
Protein cleansing · NSP15



The researchers suspect that the protein has helped remove the virus, which has not been assembled, into a complete viral copy to hide it from the defense system of the infected cell.

It's like cleaning up a messy factory producing weapons. NSP15 will not leave any heaps of unexploded ordnance and warheads on the floor, so that the factory guard will not detect its weapons production.

```
agaguuuagaaaauguggcuuuuaauguuguaaauaagggacacuuugauggacaacagggugaaguac
caguuucuaucauuaauaacacuguuuacacaaaaguugaugguguugauguagaauuguuugaaaaua
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uacaa
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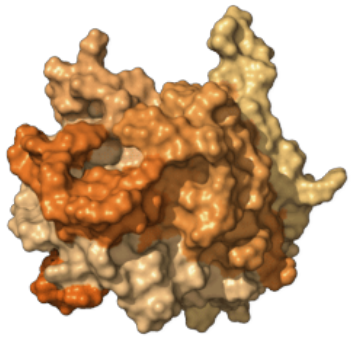
Another camouflage protein · NSP16



NSP16 works with NSP10 to help the viral RNA escape cell-protecting proteins, which is tasked with finding and shredding every viral RNA it sees.

```
ucuagucaagcguggcaaccggguguugcuaugccuaaucuuuacaaaaugcaaagaaugcuauuagaa
aagugugaccuucaaaauuauggugauagugcaacauuaccuaaaggcauaaugaugaaugucgcaaaa
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guuacaaaagaaaaugacucuaaagagggguuuuuucacuuacauuuguggguuuauacaacaaaagcua
gcucuuggaggguuccguggcuauaaagauaacagaacauucuuggaaugcugaucuuuauaagcucaug
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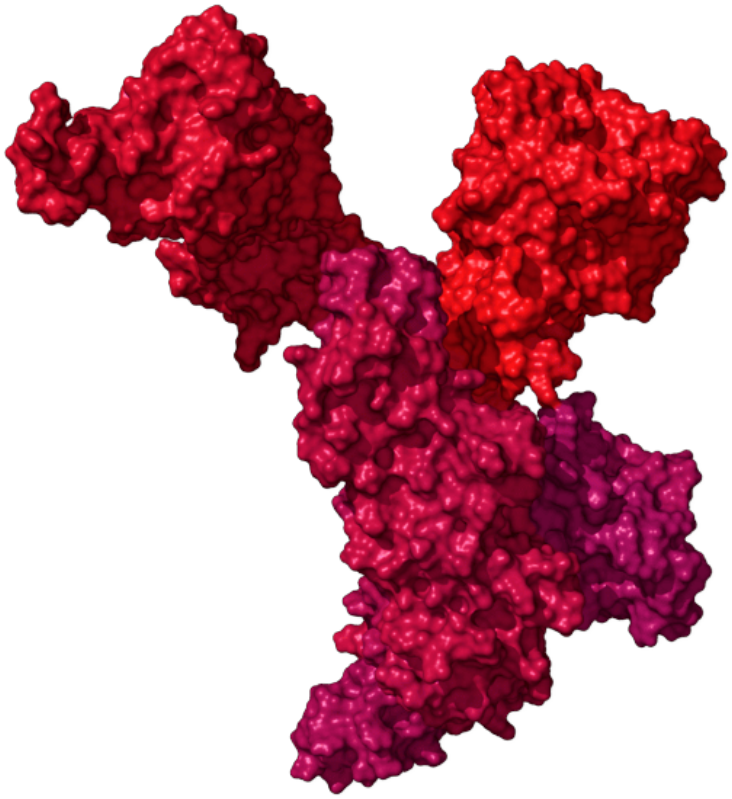
aaagguagacuuauaauuagagaaaacaacagaguuguuauuucuagugauguucuuguuaacaacuaa
acgaaca
```

Prickly Protein · S

Prickly protein is one of the four structural proteins - S, E, M and N - that form the corona virus's outer shell, protecting the inner RNA nucleus. This protein also helps assemble and release new copies of the virus.



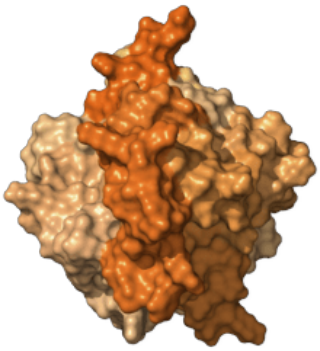
The S proteins stack up in triples, and it is this trio that creates a spine protruding from the virus surface. Crown-shaped thorns help corona viruses get their names.

A part of the thorn can expand and attach to a protein called ACE2 (yellow inside), in the human lungs. The virus can then invade the cell.

The genetic sequence encoding the SARS-CoV-2 prickly protein has a 12-character insertion sequence: ccucggcgggca. It is a mutation that helps the spines connect closely with human cells - an important step in the evolution of corona virus from a strain that infects bats and other species to infect and cause disease in humans. .

Several scientific groups are currently designing vaccines that can prevent these prickly proteins from sticking to human cells. If unable to stick, the virus simply cannot enter our lungs.

Who opened the way · ORF3a



The SARS-CoV-2 genome also encodes a group of proteins called accessory proteins. They help change the environment inside the infected cell, to make it easier for viruses to copy and multiply.

The ORF3a protein pokes a hole in the infected cell membrane, making it easier for the new virus to replicate. It also causes inflammation, one of the most dangerous symptoms of COVID-19.

```
auggauuuguuuaugagaaucuucacaauuggaacuguaacuuugaagcaaggugaaaucaaggaugcu
acuccuucagauuuuguucgcgcuacugcaacgauaccgauacaagccucacucccuuucggauggcuu
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caacuagcacucuccaaggguguucacuuuguuugcaacuugcuguuguuguuuguaacaguuuacuca
caccuuuugcucguugcugcuggccuugaagccccuuuucucuaucuuuaugcuuuagucuacuucuug
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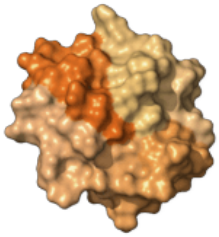
cagauuggugguuauacugaaaaauggggaaucuggaguaaaagacuguguuguauuacacaguuacuuc
acuucagacuauuaccagcuguacucaacucaauugaguacagacacugguguugaacauguuaccuuc
uucaucuacaauaaaauuguuugaugagccugaagaacauguccaaauucacacaacucgacgguucaucc
ggaguuguuaauccaguaauggaaccaauuuaugaugaaccgacgacgacuacuagcgugccuuuguaa
gcacaagcugaugaguacgaacuu
```

The ORF3b code also has duplicates on RNA, but scientists are not sure whether SARS-CoV-2 will use this gene to make proteins.

Protein shell · E



Shell protein is a structural protein that helps form the virus's oil bubble. But once the virus invades infected cells, this protein also undertakes another task. Researchers have discovered that the E-envelope protein binds to proteins that turn on and off human genes, altering our cell's genetic activity patterns.

```
auguacucauucguuucggaagagacagguacguuaauaguuaauagcguacuucuuuuucuugcuuuc
gugguauucuugcuaguuacacuagccauccuuacugcgcuucgauugugugcguacugcugcaauauu
guuaacgugagucuuguaaaaccuucuuuuuacguuuacucucguguuaaaaaucugaauucuucuaga
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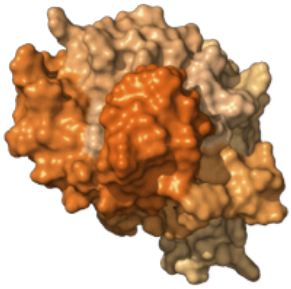
cc
```

Protein membrane · M



This is another structural protein that forms part of the outer shell of the SARS-CoV-2 virus.

```
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auaggguuuccuauuccuuacauggauuugucuucuacaauuugccuaugccaacaggaauaggguuuuug
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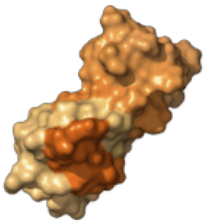
cagcguguagcaggugacucaggguuuugcugcauacagucgcuacaggauuggcaacuauaaauuaaac
acagaccauuccaguagcagugacaauauugcuuugcuuguacaguaagugacaacag
```

Signal blocker · ORF6



This accessory protein blocks the signals that infected cells send to the immune system. It also blocks some cell anti-virus proteins, others like polio and the flu also have this signal blocker.

```
auguuucaucucguugacuuucaggguuacuauagcagagauauuacuaauuauuaugaggacuuuuaaa
guuuccauuuggaaucuugauuacaucauaaaccucauaauuaaaaauuuaucuaagucacuaacugag
aauaaaauauucucaauuagaugaagagcaaccaauggagauugauuaaacgaac
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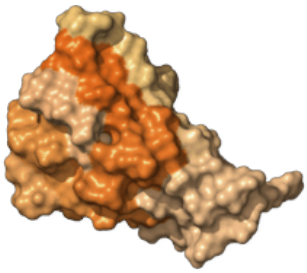
Virus release · ORF7a



When new SARS-CoV-2 viruses are replicated and try to escape an infected cell, the cell can trap them with proteins called tetherin. Several studies show that ORF7a blocks the supply of tetherin from infected cells, allowing more viruses to escape.

The researchers also discovered that this protein can activate infected cells suicide - thereby killing cells and lung tissue.

```
augaaaauuauucuuuucuuggcacugauaacacucgcuacuugugagcuuuaucacuaccaagagugu
guuagagguacaacaguacuuuuaaaagaaccuugcucuucuggaacauacgagggcaauucaccauuu
cauccucuagcugauaacaaauuugcacugacuugcuuuagcacucaauuugcuuuugcuuguccugac
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uauuccuuguuuuaauuaugcuuauuaucuuuugguucucacuugaacugcaagaucauaaugaaacuu
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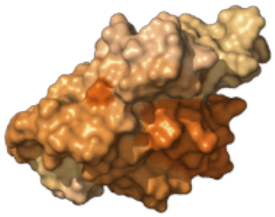
```

ORF7b also has a duplicate RNA segment, but it is not clear whether this gene is doing anything or not.

Secret protein · ORF8



This gene encoding the accessory protein of SARS-CoV-2 is significantly different from other corona viruses. Researchers are debating its use for viruses.

```
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ucauguacucaacaucaaccauauguaguugaugacccguguccuauucacuucuauucuaaaugguau
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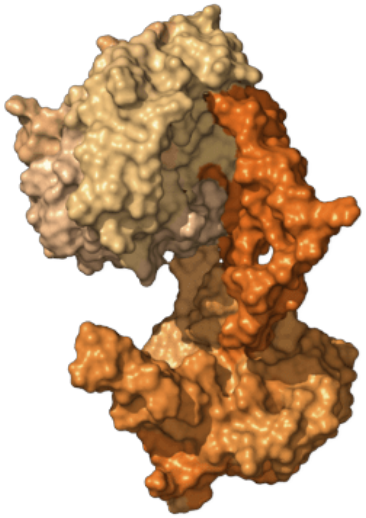
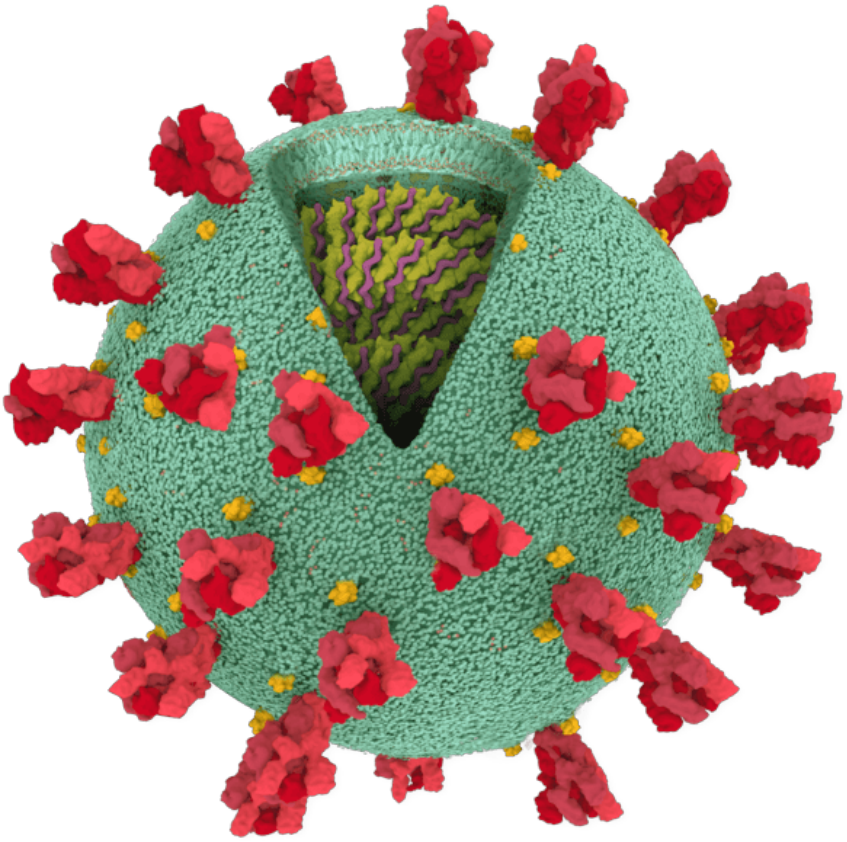
ccuaaauuggguagucuuguagugcguuguucguucuaugaagacuuuuuagaguaucaugacguucgu
guuguuuuagauuucaucuaaacgaacaaacuaaa
```

Nucleocapsid protein · N



The N protein protects the viral RNA, keeping it stable inside the virus. Many N proteins bind to each other in a long spiral, wrapping and winding RNA:



```
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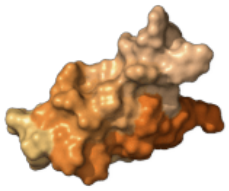
aaaaaggacaaaaagaagaaggcugaugaaacucaagccuuaccgcagagacagaagaaacagcaaacu
gugacucuucuuccugcugcagauuuggaugauuucuccaaacaauugcaacaauccaugagcagugcu
gacucaacucaggccuaaacucaugcagaccacacaaggcag
```

The accessory proteins ORF9b and ORF9c have RNA duplicates. ORF9b blocks interferon, an important molecule that helps cells fight viruses, but it is unclear whether ORF9c is useful.

Secret protein · ORF10



The SARS-CoV-2 closely related corona viruses do not have this small accessory protein-coding gene, so it is difficult to know what role it plays.

```
augggcuauauaaacguuuucgcuuuuccguuuacgauauauagucuacucuugugcagaaugaauucu
cguaacuacauagcacaaguagauguaguuaacuuuaaucucacauag
```

The line ends

The corona virus genome ends with a piece of RNA that shuts down the cell's protein-making machinery. Then, it encloses a string of repeated aaaaaaaaaaaa characters:

```
caaucuuuaaucaguguguaacauuagggaggacuugaaagagccaccacauuuucaccgaggccacgc
ggaguacgaucgaguguacagugaacaaugcuagggagagcugccuauauggaagagcccuaaugugua
aaauuaauuuuaguagugcuaucccccaugugauuuuaauagcuucuuaggagaaugacaaaaaaaaaaa
aaaaaaaaaaaaaaaaaaaaaa
```

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