

Immunity and COVID-19 Vaccines

Back to Basics

What is immunity?

In simple terms, immunity is the body's ability to protect itself against infections. The immune system is designed to identify disease-causing substances, such as bacteria and viruses, and get rid of them. Immunity is essential for staying healthy and ultimately, survival.

How does the immune system work?

Your immune system is a large network of organs, white blood cells, proteins, and chemicals. It can tell which cells are yours and which are not, and when foreign substances are detected, the immune system attacks and kills them. The immune system also remembers the germs you've been exposed to and builds antibodies to protect you from them in the future. It's important to know that germs and viruses are very adaptive and can change over time, making us vulnerable to new infection.

Sometimes our immune system doesn't work as it should. For example, an immune system may fight a foreign substance, but it isn't strong enough to kill all the invading substance, resulting in an infection. Sometimes the immune system may fight when there is no foreign substance in the body, or when all germs have already been killed. This can result in an allergic reaction or be the sign of an autoimmune disease.

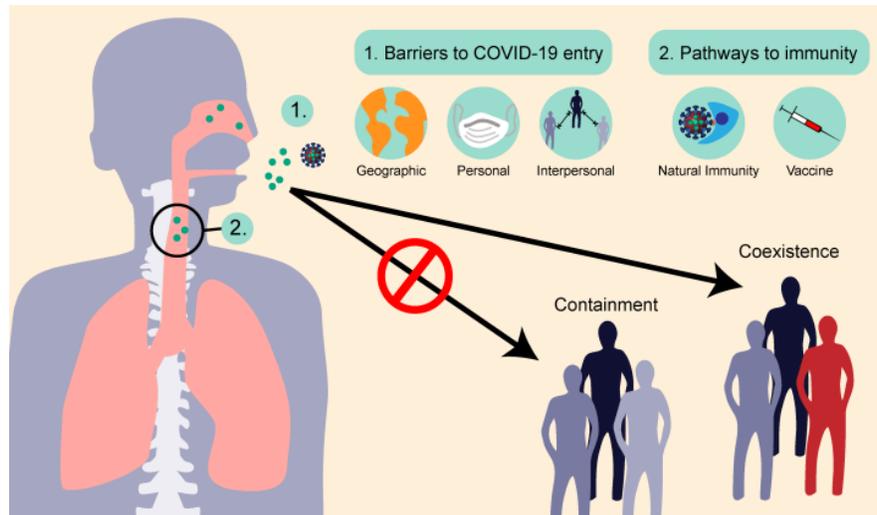
Types of Immunity

Active Immunity: Occurs when exposure to a disease organism triggers the immune system to produce antibodies to that disease. Active immunity can take some time to develop but is long-lasting.

- **Natural Immunity:** acquired from exposure to the disease organism through infection with the actual disease.
- **Vaccine-Induced Immunity:** acquired through the introduction of a killed or weakened form of the disease organism through vaccination.

Passive Immunity: Provided when a person is given antibodies to a disease rather than producing them through his or her own immune system. An example of this is a newborn baby acquiring immunity from its mother through the placenta. Passive immunity is immediate, but wanes quickly.

SARS-CoV-2 and COVID-19 Infection



The SARS-CoV2 virus can invade cells, produce proteins and cause COVID-19 infection throughout the body, especially in the lungs. As with other infections, the immune system responds by recognizing the proteins as a foreign substance and producing antibodies to fight against them. As mentioned previously, the antibodies not only help kill the virus, but may offer protection from reinfection for a brief time.

For most healthy people, the body's immune system can do its job and fight COVID-19 infection without severe or deadly consequences. That is not the case for those who are in high-risk categories (e.g. immunocompromised, seniors) or have pre-existing health conditions.

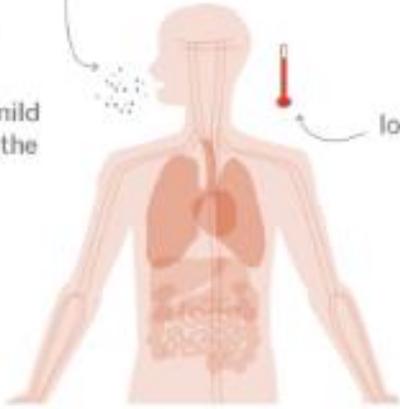
Facts

- ✓ A person can be infected with COVID-19 more than once
- ✓ Natural immunity from COVID-19 infection is not guaranteed
- ✓ COVID-19 has killed more than one million people in the United States and over 6 million people worldwide (July 2022)

Mild
Most cases of coronavirus infection are mild and resemble the flu.

dry cough

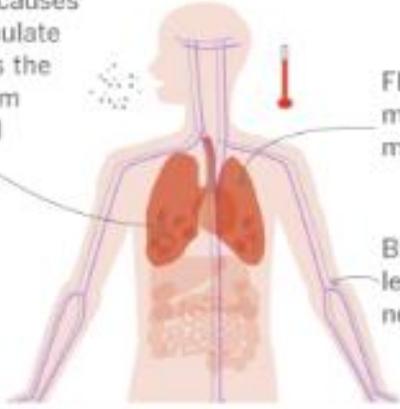
low-grade fever



Severe
Inflammation causes fluid to accumulate in the lungs as the immune system fights the viral infection.

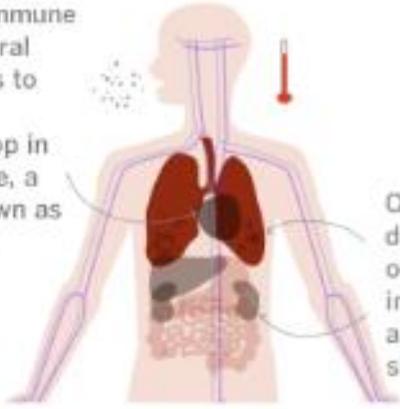
Fluid in the lungs makes breathing more difficult.

Blood oxygen levels fall below normal.



Critical
An outsized immune response to viral infection leads to sepsis and a dangerous drop in blood pressure, a condition known as septic shock.

Organs fail due to lack of oxygen, inflammation, and septic shock.



JAMA

Jennifer Lu / Los Angeles Times

The COVID-19 Vaccines

Since there is no way to tell if a person has developed any natural immunity after COVID-19 infection, and if they have, how strong it is or how long it will last, vaccination is most effective at reducing the risk of transmission, severe illness, and death.

- ❖ The [Centers for Disease Control and Prevention](#) (CDC) recommends COVID-19 primary series vaccines for everyone ages 6 months and older, and COVID-19 boosters for everyone ages 5 years and older, if eligible.
 - Some people may be eligible for [additional boosters](#).
- ❖ Three COVID-19 vaccines are authorized or approved for use in the U.S. to prevent COVID-19. The *Pfizer-BioNTech and Moderna COVID-19 mRNA vaccines are preferred*.
- ❖ The COVID-19 vaccines do not contain any aborted fetal cells or fetal tissue.
 - Fetal cell lines (cells grown in a laboratory based on aborted fetal cells collected generations ago) were used in testing during research and development of the mRNA vaccines, and during production of the Johnson & Johnson vaccine.

How do vaccines work?

Any time your body meets a new virus, your immune system must figure out what antibodies it needs to make to fight it. That can take a while.



The COVID-19 vaccines give you a head start by activating the correct immune response without ever exposing you to the virus.

Your immune system then records what it learned in "memory cells" so that it can activate quickly if you're ever exposed to COVID-19.

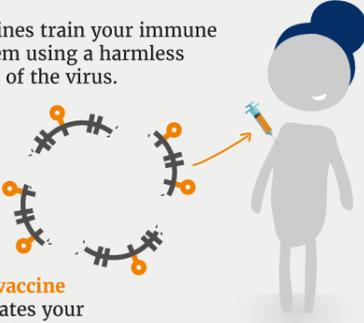
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COVID-19, long-term immunity and vaccines



Vaccines train your immune system using a harmless form of the virus.



The **vaccine** activates your **adaptive immune response**.

The adaptive immune response involves:

- B cells** that make highly specific **antibodies** to stop the virus getting into your cells.
- T cells** that can help stimulate the B cells and kill any infected cells.

These cells remember the virus and remain in the body. This is **immune memory**.

If you encounter the real virus in the future, your immune system responds faster and more effectively to prevent infection. This is **long-term immunity**.



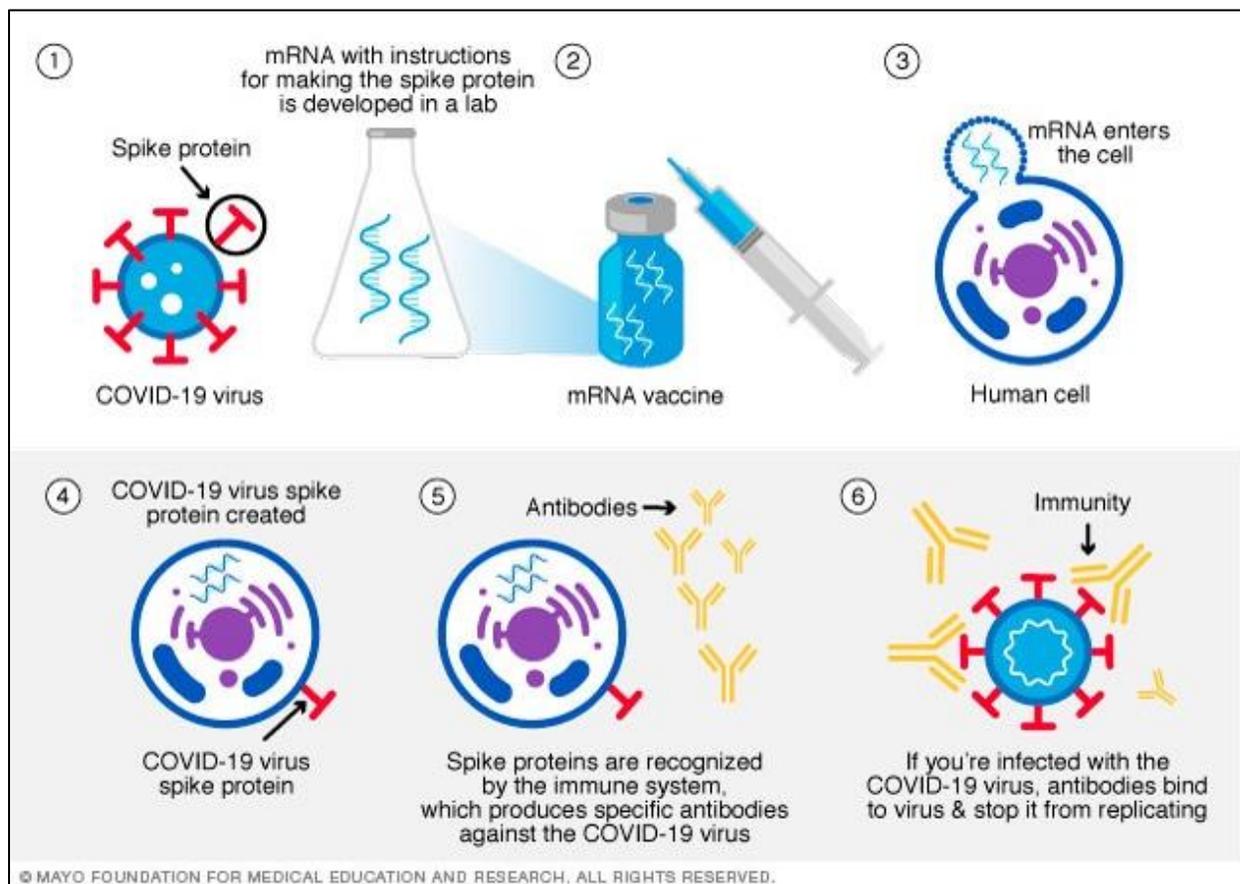
An effective COVID-19 vaccine will produce a strong, long-term, adaptive immune response. It might stimulate B cells and specific antibodies or T cells or a combination of both.

mRNA Vaccines (Pfizer-BioNTech, Moderna)

Messenger RNA (mRNA) vaccines use genetic material created in a laboratory to teach our cells how to make a protein, or piece of protein, that will trigger an immune response inside our bodies. Once the immune system is activated it will begin producing antibodies, which protect us from getting infected in the future if we are exposed to the real virus.

- Messenger RNA vaccines are [safe and effective](#).
- COVID-19 mRNA vaccines cannot give someone the virus that causes COVID-19 or other viruses.
 - mRNA vaccines do not use the live virus that causes COVID-19.
- They do not affect or interact with our DNA in any way.
- Our cells break down mRNA and get rid of it within a few days after vaccination.

[How mRNA COVID-19 Vaccines Work – CDC – Infographic, English](#)

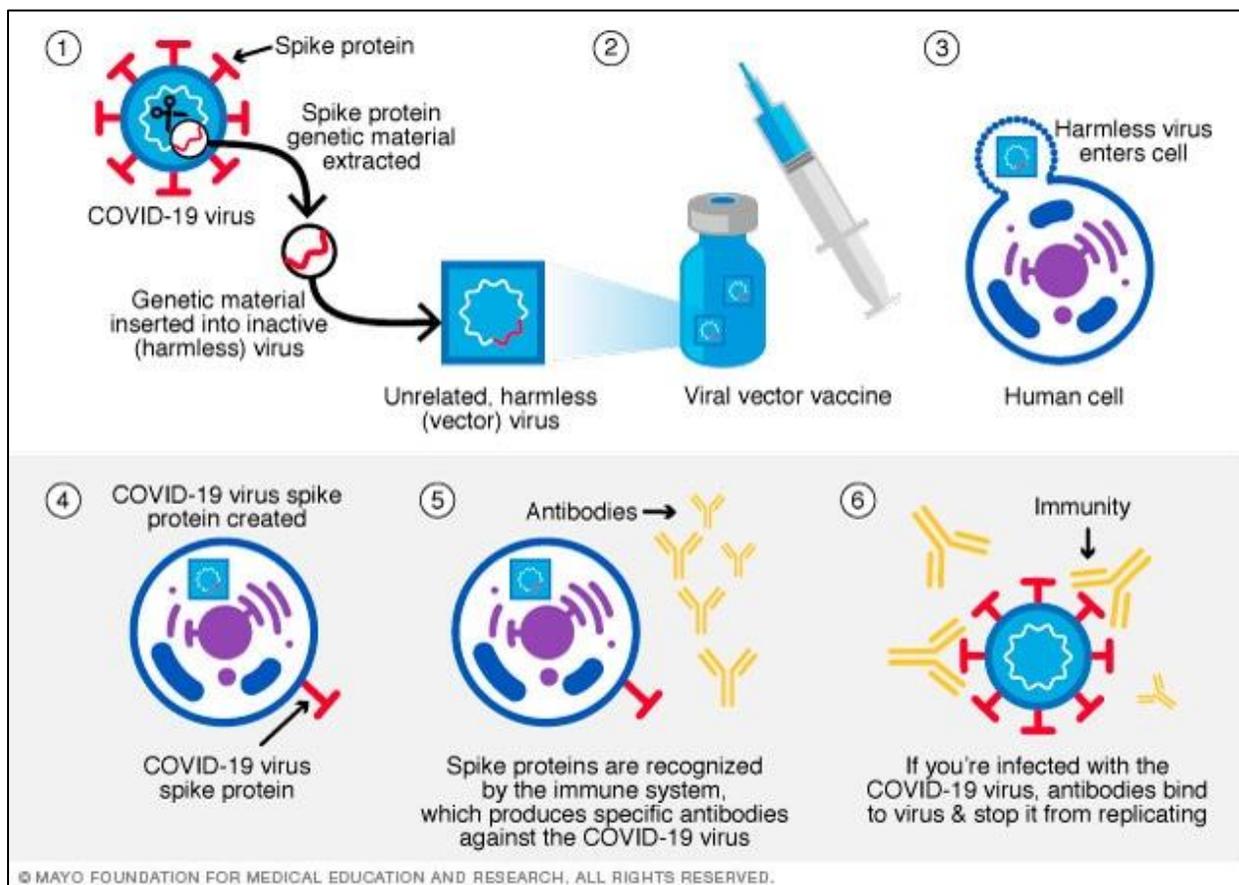


Vector Vaccines (Johnson & Johnson/Janssen)

The vector vaccine uses a modified version of a different virus (which is harmless) to deliver genetic material from the COVID-19 virus into the body. When injected, the body does not recognize it and the immune response is triggered to begin producing antibodies. The body fights off the invasion of foreign cells from the vaccine just as it would if it were a real viral infection, which is why some people experience minor side effects when they are vaccinated. After the body has completed the process, it will have learned how to protect against the virus that causes COVID-19.

- Viral vector vaccines are [safe and effective](#).
- COVID-19 viral vector vaccines cannot give someone the virus that causes COVID-19 or other viruses.
- They do not affect or interact with our DNA in any way.
- The spike protein, like other proteins our bodies create, does not last long in our body (up to a few weeks).

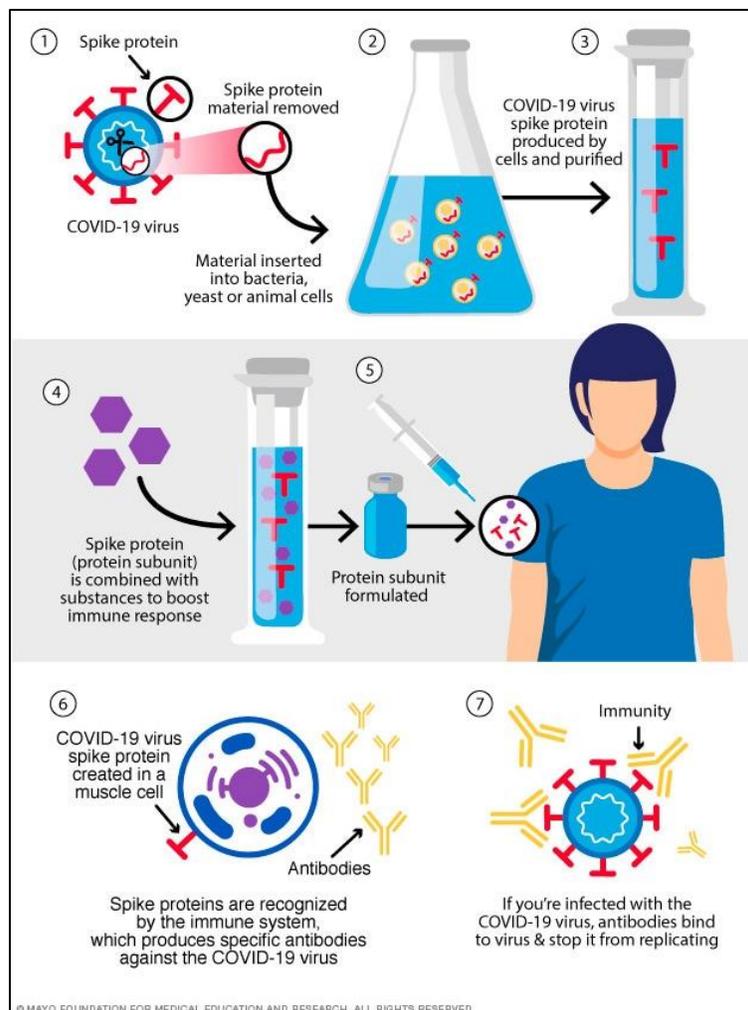
[How Viral Vector COVID-19 Vaccines Work – CDC – Infographic, English](#)



Protein Subunit Vaccine (Novavax)

Novavax utilizes an older, more familiar technology. Protein subunit vaccines contain pieces (proteins) of the virus that causes COVID-19. These virus pieces are the spike protein. The vaccine also contains another ingredient called an adjuvant that helps the immune system respond to that spike protein in the future. Once the immune system knows how to respond to the spike protein, the immune system will be able to respond quickly to the actual virus spike protein and protect you against COVID-19.

- Protein subunit COVID-19 vaccines are [safe and effective](#).
- Protein subunit COVID-19 vaccines do not contain any live virus.
- Protein subunit COVID-19 vaccines cannot cause infection with the virus that causes COVID-19 or other viruses.
- They do not affect or interact with our DNA.
- Learn more about [Novavax COVID-19 Vaccine, CDC](#)

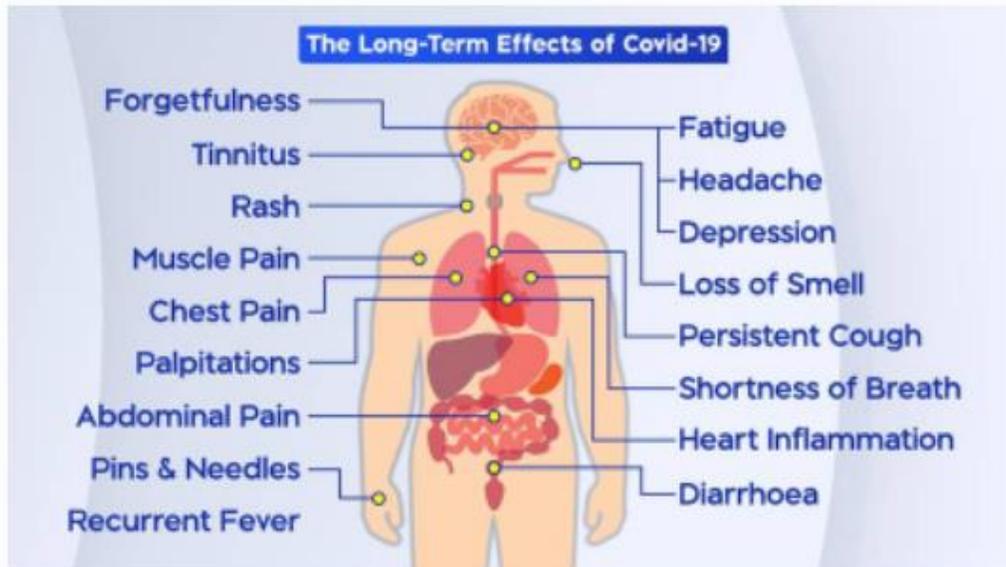


Long COVID

Some people that have been infected with the virus that causes COVID-19 may experience long-term effects from the illness, which is known as post-COVID conditions or long COVID. These can be new, returning, or ongoing health problems that people experience after first being infected.

Given that COVID-19 is a new disease, there is still much we don't, especially what the long-term health implications are for those that have been infected. Initial research has indicated the following:

- Anyone who has had COVID-19 could experience post-COVID conditions, regardless of whether their infection was mild or severe (or had no symptoms at all)
- People who were unvaccinated at the time of COVID-19 infection may be at higher risk of developing long COVID
- Currently, there is no test to determine if someone has long COVID
- Long COVID is considered a disability under the Americans with Disabilities Act (ADA)



Some long-term effects of Covid-19 according to the WHO. (Source: 1 NEWS)

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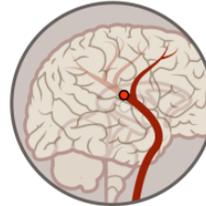
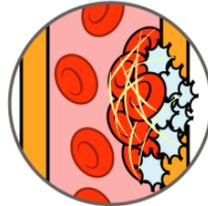
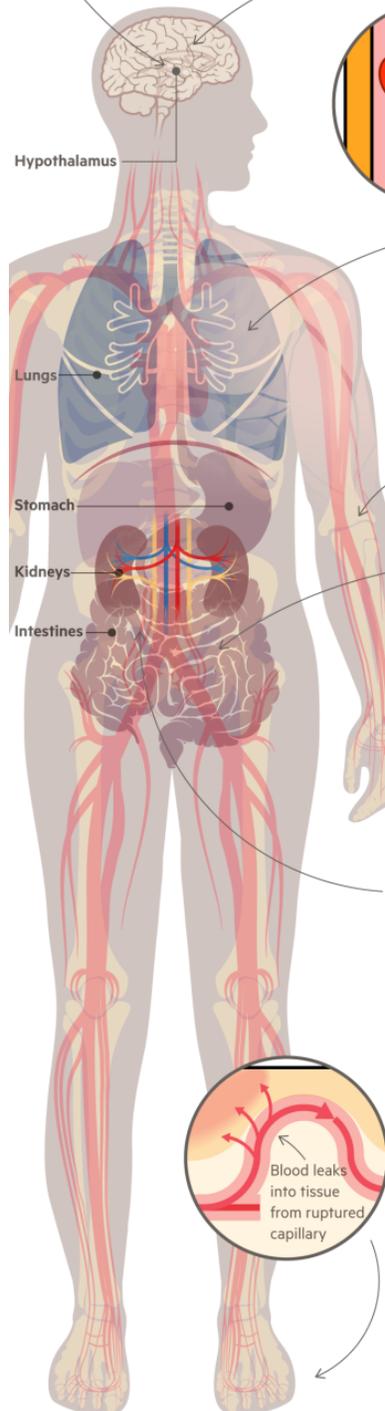
APPENDIX

How coronavirus affects the body from top to toe

Fever Body temperature rises to try and incapacitate heat-sensitive viruses when the hypothalamus receives signals from immune cells

Blood clots and strokes
An accumulation of blood platelets and proteins plugs broken blood vessels (below). Once healed, these clots dissolve

If an excessive immune response to Covid-19 causes abnormal clotting, blood vessels in the brain may be blocked, triggering a stroke (below). Symptoms depend on the region affected



Coughing Reflex
reaction expels air rapidly from the lungs to clear irritants from airways

Shortness of breath
As the virus reduces lung capacity, breathing becomes difficult



Muscle and joint pain
Viral inflammation in joints and muscles (left) can cause pain and stiffness

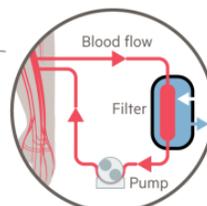
Post-viral fatigue
Infections often lead to long-term fatigue and weakness

Intestinal (enteric) symptoms
Inflammation is a complex immune response intended to carry disease-fighting molecules to the site of infection and carry away debris. Excessive intestinal inflammation can cause:

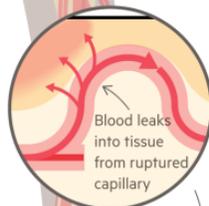
Vomiting Reflex
contraction of diaphragm and abdominal muscles empties the stomach contents via the mouth, ridding the body of toxins

Diarrhoea Unable to absorb fluid, the intestine's bowel movements become watery

Abdominal pain



Kidneys These organs filter the blood, balancing chemicals and removing waste and excess water as urine. If they fail, blood can be circulated through a dialysis machine (left), an artificial filter replicating kidney function



Rashes, skin lesions and 'Covid toes'
When the smallest blood vessels, capillaries, become inflamed, leakage causes spots and rashes on the skin. The effect is similar to chilblains (left), which form on fingers and toes when capillaries contract in the cold and then expand rapidly as they warm up – rupturing and causing irritation and swelling as blood leaks out

Graphic: Ian Bott Sources: NHS; FT research © FT