Here's why washing your hands with soap for 20 seconds protects you from COVID-19

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Scientists say that even with the best and most expensive research available, a vaccine against SARS-CoV-2, the virus that causes COVID-19, is at least a year away. Scientists also say that the worst enemy of the virus is that cheap soap by your sink.

That's because of simple chemistry. In soap lather, a combination of molecules assemble into bubble-like structures called micelles that trap viral matter and other biomaterials—grease, oil, dirt—and rinse them down the drain.

The soaps we use contain a class of compounds called surfactants, which can neutralize germs in our skin such as SARS-CoV-2 and other coronaviruses, pathogens with a crown-like structure and an outer membrane made of lipid molecules and proteins.

"Surfactants basically pry open coronavirus particles and encapsulate viral molecules within micelles suspended in the lather clinging to your hands," says Thomas Gilbert, an associate professor of chemistry and chemical biology at Northeastern. "That allows the deactivated viral material to be washed away as you rinse your hands."

SARS-CoV-2 spreads through the air in the form of small particles that an infected person near you breathed, sneezed, coughed, or let loose while talking. They can enter your body through the eyes, mouth, or nose. Recent findings suggest that those germs can also survive hours, even days, when they land on objects made of plastic, metal, and cardboard.

Because the virus can also be contracted by transporting germs from such contaminated objects into your body after you touch your face, public health officials have pushed handwashing as one of the best ways to protect against COVID-19.

But it has to be done the right way. The gold standard involves scrubbing your hands thoroughly with soap and clean water for at least 20 seconds.

That time allows soap to form lather that contains pin-like surfactant molecules with two ends. One is a hydrophilic one that likes to interact with water. The other end is a hydrophobic one that avoids water but readily interacts with other similar biological materials, such as oils, fats—and the makeup of the outer membrane of coronaviruses.

With their water-avoiding ends pointing inwards and their water-loving ends out, the surfactants in micelles can encapsulate and carry the viral debris away from our hands, with the help of water. In other words, soap molecules basically make the insoluble viral molecules easily soluble in water (and thus transportable off of your hands and down your drain).

But your hands have many surfaces and parts to clean individually, and the lather needs to cover all

of them to capture the germs within—palms, wrinkles, fingernails, between fingers, under rings, bandaids, or splints you may have on an injured finger. If you are doing it right, 20 seconds allows for enough time to be thorough, and for soap molecules to do their job on the entire hand.

"It takes time to clean all those surfaces effectively," Gilbert says. "If you try to do it in half that time, you're probably not going to effectively clean all of them."

That effectiveness of soap can be seen when people use it to wash things like dirt off their hands, Gilbert says. Washing dirt can also show that if you aren't doing it right, even 20 seconds won't be enough to clean up your hands. Same goes for germs like SARS-CoV-2.

"You can do a pretty effective job and you can actually tell you're doing a good job with soap and water, because if there is any dirt or anything visible on your skin, you can see how long it takes to remove it," Gilbert says. "If you're using sanitizer, you're not going to get that same sort of visual message."

Disrupting and sequestering viruses and other contaminations with soap and water is different than using disinfectants and sanitizers, which are designed to kill germs but not remove them from your skin.

Soap cleans just as well, Gilbert says. Still, the chances of getting to all corners and wrinkles on your skin are better with 20 seconds of soap lathering than they are when rubbing your hands with sanitizer.

That also means that any and all types of soap can get the job done, including the basic soaps we use in public bathrooms, airports, restaurants.

Even household items such as dish soap would work, Gilbert says, although those harsher soaps are not meant to be used extensively on your hands and can irritate the skin.

"All hand soaps do basically the same thing in terms of cleaning because they all contain surfactants material," Gilbert says. "[That] gives them the power to solubilize viral debris and the residues of other biological material, such as mucus and other fluids from an infected person's respiratory system."

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