COVID-19 and Treatment of Drinking Water

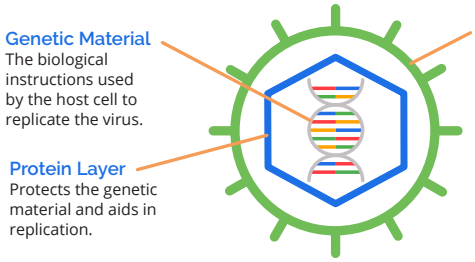
SARS-CoV-2 is the virus that causes COVID-19. It is one of the millions of viruses that exist in nature. While much is still unknown about this novel coronavirus, the science behind providing safe drinking water that is free of harmful viruses and pathogens is well established. Modern water and wastewater treatment facilities are designed to remove and destroy a multitude of viruses and pathogens.

What We Know About SARS-CoV-2 and COVID-19

- No reported transmission of virus via drinking water.
- No virus inactivation studies are currently available.
- Virus is 82% similar to SARS-CoV (SARS epidemic of 2003). Inactivation data on SARS-CoV should be used in the interim. Wang *et al.* (2005) showed:
  - SARS-CoV is inactivated after 2 days in water without disinfectant at 20°C.
  - CT values of 0.4 to 2.9 are required for inactivation using free chlorine at 20°C.
  - CT values of more than 80 are required for inactivation using chlorine dioxide at 20°C. Typically, however, chlorine dioxide is nearly as effective as free chlorine for inactivation of viruses.
  - Darnell *et al.* (2004) showed SARS-CoV is inactivated by ultraviolet light at 254 nm.
  - No inactivation data available for other disinfectants (combined chlorine, ozone peroxide).

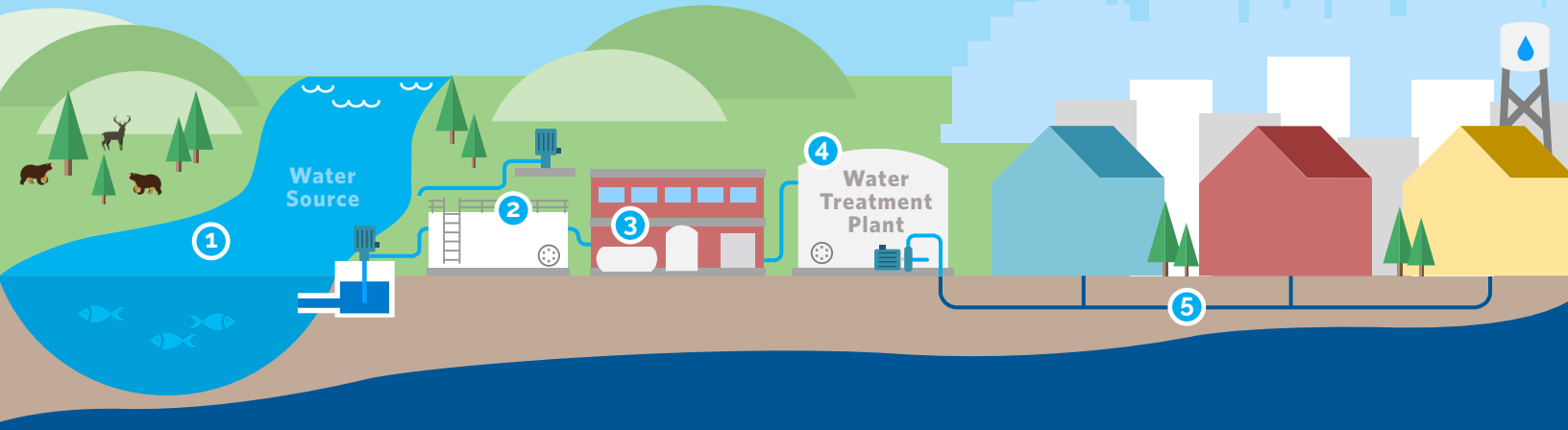
Anatomy of a Virus

A virus is a simple, non-living pathogen consisting of strands of genetic material encapsulated in a protein shell, and in some cases an extra viral envelope. Viruses replicate by infecting susceptible cells and instructing cellular processes to produce more viruses. The viral envelope and protein shell are critical to infection of host cells. Destruction of the viral envelope and/or protein shell is key to virus inactivation.



Knowledge Gaps

SARS-CoV-2 is an enveloped virus. Generally, enveloped viruses are more readily inactivated than the non-enveloped viruses used to establish federal disinfection criteria. However, research on the effectiveness of water treatment disinfectants on the specific inactivation of SARS-CoV-2 is a critical need to ensure public water supply systems are adequately protected.



Protection of Public Water Supplies from Viruses & Pathogens

Public water systems are protected from viruses and other pathogens through preservation of water sources and through treatment. Treatment for viruses depends on two mechanisms: removal and/or destruction. Removal of viruses is achieved using physical processes to settle and filter the water of suspended solids and particulates. As solids are removed, so are pathogens. Physical removal typically eliminates over 99% of viruses in the water supply. Destruction of the remaining viruses and other pathogens is accomplished through disinfection. Disinfection criteria is established by the EPA to destroy (or inactivate) the toughest viruses. Through removal and destruction, water treatment facilities must achieve an overall removal of more than 99.99% of viruses.

1 Source Water Protection

Protection of water sources is the first barrier to pathogens in drinking water. Methods include limiting human activities and preventing polluting waste streams from contaminating the water source. Still, some viruses and pathogens from human and animal waste are present and require treatment to protect public health.

2 Sedimentation

Sedimentation consists of conditioning the solids and particulates in the untreated water to settle to the bottom of the process where they are removed. It is the primary means for removal of solids in the water treatment process and is the first step of pathogen removal.

3 Filtration

Filtration most often consists of passing water through a bed of granular media, but can also be achieved using pressurized membranes. Filtration is the last solids removal step in the water treatment process and is also an effective means for pathogen removal.

4 Primary Disinfection

The purpose of primary disinfection is to inactivate water-borne pathogens, including viruses. Disinfection is commonly achieved using chlorine, combined chlorine (chloramines), chlorine dioxide, ozone gas, and/or ultraviolet (UV) light. Virus inactivation criteria is based upon disinfectant efficacy on tough and resistant, non-enveloped viruses (e.g. Hepatitis A, rotavirus).

5 Secondary Disinfection

Secondary disinfection is the final barrier against water-borne pathogens. Utilities are required to maintain a low concentration of disinfectant in the distribution system piping that conveys drinking water to customers. The disinfectant residual protects drinking water from growth of bacteria and other pathogens in water mains and household piping.

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