

DISINFECTION BYPRODUCT FORMATION AND REGULATORY THRESHOLDS

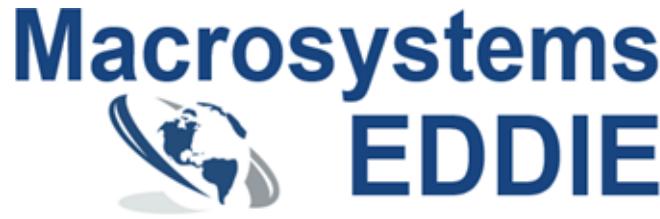
Lofton, M.E., Cooke, R.L., and Carey, C.C. 20 September 2025.

Macrosystems EDDIE: Exploring Tradeoffs in Water Quality Management Using Environmental Data.

Macrosystems EDDIE Module 10, Version 1.

https://serc.carleton.edu/eddie/teaching_materials/modules/module10.html

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*Environmental Data-Driven Inquiry & Exploration
in Macrosystems Ecology*



SERC the Science Education Resource Center at Carleton College



Chlorination is a common method to disinfect drinking water

- **Disinfection** is the process by which harmful pathogens, such as bacteria, viruses, fungi, and protozoans, are removed from drinking water
- Disinfection is necessary to protect public health!
- **Chlorination** means treating the water with a chemical containing chlorine to kill or inactivate harmful pathogens



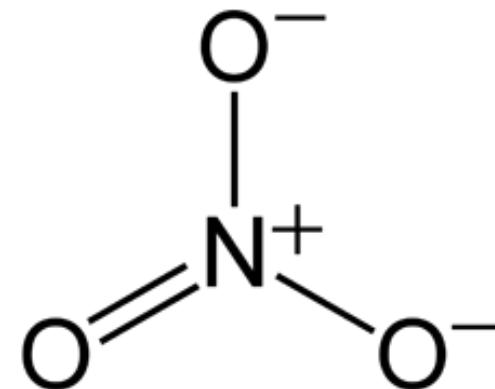
Giardia is a protozoan parasite that causes diarrhea if it is present in the water supply

DBP precursors can react with chlorine to form disinfection byproducts (DBPs)

These compounds may be organic or inorganic, and may come from natural sources or be introduced by humans



Naturally-occurring phytoplankton may release **organic** compounds that form DBPs during treatment



Nitrate is an **inorganic** compound that may form DBPs during treatment; one source of nitrate is agricultural fertilizers

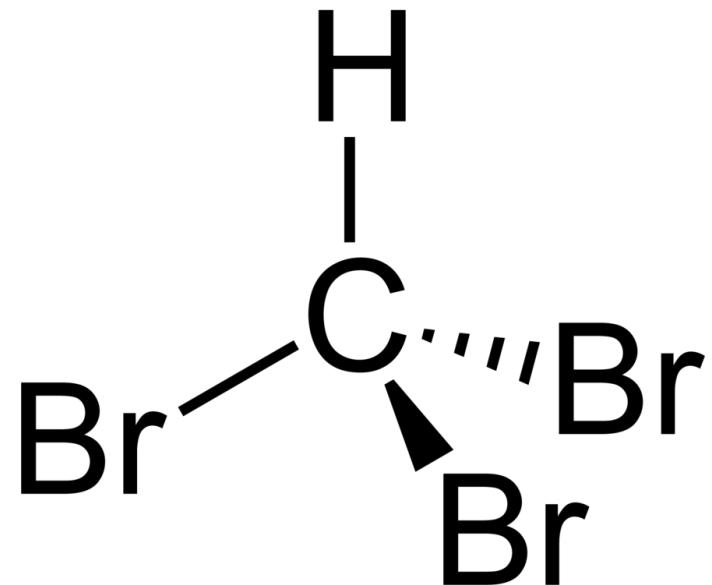
Image credits:

Phytoplankton - <https://coastalscience.noaa.gov/monitoring-and-assessments/pmn/image-gallery/freshwater-plankton-gallery/>

Nitrate molecule - <https://en.wikipedia.org/wiki/Nitrate#/media/File:Nitrate-ion-resonance-2D.png>

DBPs present health risks, including cancer

- Several DBPs are known carcinogens
- For example, researchers pooled the data from six studies in the U.S., Canada, France, Italy, Spain, and Finland and found that increased, long-term exposure to DBPs led to increased risk of bladder cancer in men



Bromoform is one example of a *trihalomethane*, the type of DBP analyzed in the pooled study.

The EPA and VDH regulate DBPs

- There are many, many kinds of DBPs (dozens or more!)
- The US EPA and the VDH regulate both total trihalomethanes (TTHM) and the five most common haloacetic acids (HAA5), as well as bromate and chlorite in drinking water
- The **MCL** is the **maximum contaminant level** permitted by the EPA and VDH in finished water

Disinfection byproduct	MCL (mg/L)
Total trihalomethanes (TTHM)	0.080
Haloacetic acids (five) (HAA5)	0.060
Bromate	0.010
Chlorite	1.0

End of slideshow – please proceed with module activities!



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