

Contamination of Water

Part A: What is contamination?

The material presented here has been prepared by Samuel Addison in April 2021, with input from Dr. Laura Richards and Prof. David Polya of the Department of Earth & Environmental Sciences, The University of Manchester, and other sources as acknowledged. The associated video recordings have been made by Samuel Addison.

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This lesson will introduce what contamination is and the main types of contamination.

Part B and C of the “Contamination of Water” lesson will investigate contamination further in respect to natural processes and human actions.

- Understand the importance of contamination and its impact on water quality
- Discuss the different types of contamination
- Compare and contrast how different contaminants derive

WHAT IS CONTAMINATION

- As discussed in lesson “Water Quality Importance and Regulatory Settings – Part A: Water Quality and Definitions” no natural water is absolutely pure.
- Chemical and physical characteristics of water are constantly changing through interaction with the environment and throughout the water cycle [1]
- Changes throughout the water cycle can have both positive and negative impacts in terms of water quality [1].

- Water can become unsafe for human consumption through contamination [1].
- Contamination can come from 2 overall sources:
 - Natural processes (focus of Part B)
 - Pollution from human activities (focus on Part C)
 - Sometimes there can be interlinkages arising from human-environment interactions

- There are two key categories of contamination
 - Chemical
 - Microbiological
- Both the chemical and microbiological contamination of water supplies are global public health threats [1].
- Remediation might be required to bring water quality to a level appropriate for its intended use (see lesson "Water Remediation Approaches for Drinking Water Supplies")

CHEMICAL CONTAMINATION

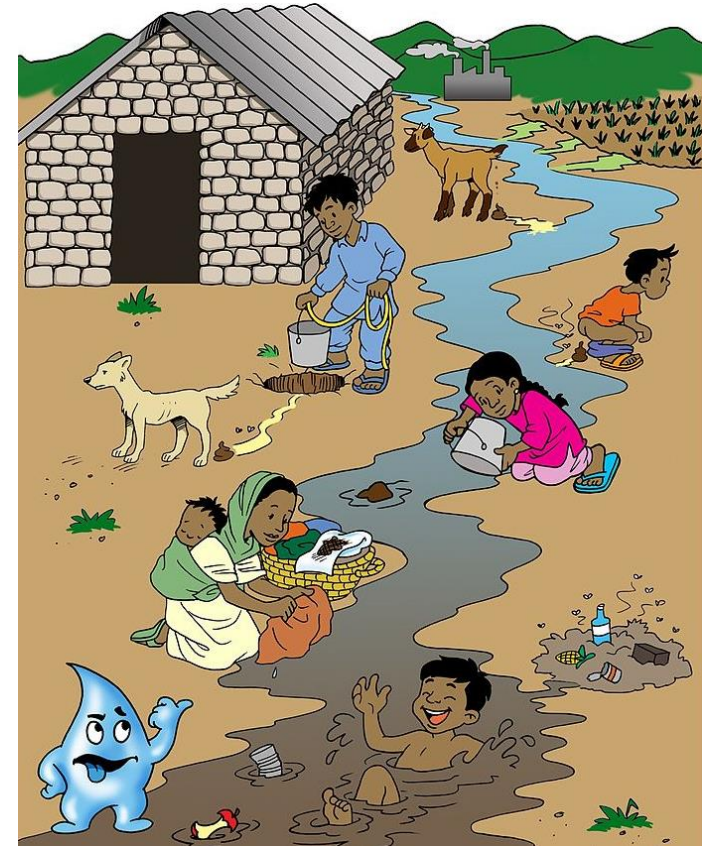
- Drinking water remediation efforts tend to primarily focus on microbiological safety first, although chemical safety is also an important consideration [1].
- As research develops chemical contamination of drinking water is increasingly recognised to be a serious threat to health [1].
- Chemical contamination leads to health problems primarily through chronic exposure although acute exposure can also be a risk [1].

- There are two sources of chemical contamination:
 - Naturally occurring chemicals
 - Anthropogenic (caused by human activity) pollutants.
- Three chemicals are of most widespread concern to human health, these are: arsenic, fluoride and nitrate [1].
- There are numerous additional chemicals that can be present in water [2] (see WHO drinking water guidelines chapter 12).

- Groundwater sources are typically the most affected by natural chemical contamination [1]
- Chemical contaminants present in the rocks and soils can be mobilized and transported in groundwater through a variety of (bio)geochemical processes [1]
- Often large areas and multiple water sources are affected, although significant variation in contamination levels from source to source occurs [1].

Anthropogenic pathways

- Other non-geogenic pollutants can be harmful chemicals released into the environment from agricultural activities, industrial processes and household waste [1]
- Two types of pollution can occur
 - Point source
 - Non-point source [1]



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MICROBIAL CONTAMINATION

- Pathogens are micro-organisms that can cause disease in humans. They fall into three major classes [1]:
 - Bacteria
 - Viruses
 - Parasites

- When thinking of water quality pathogens tend to be classed on transmission routes in the environment [1].

Category	Example
Water-borne	Diarrhoeal disease, cholera, dysentery, typhoid
Water-washed	Diarrhoeal disease, cholera, dysentery, trachoma
Water-based	Schistosomiasis
Water-related (insect vector)	Malaria, dengue fever

- Water-borne diseases are diseases caused by the ingestion of water contaminated by human or animal faeces or urine containing pathogens [1].
- Faeces contamination is one of the most serious water quality issues affecting people's health [2]
- The main water borne disease is diarrhoeal diseases [3]

- Water-based diseases are infections caused by parasitic pathogens found in aquatic host organisms [1]
- People become infected through skin contact with infected water, mainly during fishing and agricultural activities [1].

- Water-related diseases are caused by insect vectors which either breed in water or bite near water [1]
- Water-washed diseases are diseases caused by inadequate use of water for domestic and personal hygiene [2]
- These are both not directly caused by water quality, but are indirectly related [1]

- The main source of microbiological contamination is faeces, but there are other sources [1]
- When water sources are contaminated by human and animal faeces, water-borne diseases can be transmitted: the many pathogens that can be present in faeces are ingested by humans through drinking and cooking water [1]
- The interruption of the faecal-oral cycle is the key objective of most water and sanitation programmes in developing countries [1]

RADIOLOGICAL CONTAMINATION

- The contribution of drinking water to overall radioactive exposure is very small (typically less than 5%) [1]
- Nearly half of the total natural radiation exposure we receive comes from a radioactive gas from rocks and soil [1]
- Radiological contamination of water is generally much less widespread than microbial or chemical contamination

SUMMARY

- Water quality can be affected negatively by contamination.
- Contamination of water can be caused both by natural processes and human actions.
- Contamination has three main types: chemical, microbiological and radiological.

LEARNING EXERCISE

- Think about the key differences between microbial, chemical and radiological contamination.
- Examples of differences to think about are:
 - What are the sources of each?
 - What are the impacts of contaminated water?

The references and further resources on the next slides will be able to provide more information to think about this, and part B and C of this lesson will also focus more on these questions.

REFERENCES & FURTHER RESOURCES

- UNICEF, 2008. UNICEF Handbook on water quality. *United Nations Childrens Fund, New York/USA.*

<https://www.unicef.org/documents/2008-unicef-handbook-water-quality>

- World Health Organization, 2011. *Guidelines for drinking-water quality*. World Health Organization.

[https://www.who.int/water sanitation health/publications/2011/dwq_guidelines/en/](https://www.who.int/water_sanitation_health/publications/2011/dwq_guidelines/en/)

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