

## **TOPIC: CONTAMINATION OF WATER**

### **SUB-TOPIC: PART A: WHAT IS CONTAMINATION?**

#### **Supporting Transcript**

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#### **Slide 1**

Hello, my name is Sam Addison and welcome to this lesson on contamination and specifically on what contamination is.

#### **Slide 2**

In this lesson we will begin with an introduction and the objectives. This will be followed by the main part of the lesson where we will discuss what contamination is, and then look at chemical contamination and microbial contamination. The end of the lesson will have a learning exercise and details on further learning and information.

#### **Slide 3**

This lesson will be introducing the process of contamination and will be followed by lesson part B and C of “contamination of water” where contamination will be further investigated in respect to natural processes and human actions.

#### **Slide 4**

The objectives of this lesson are to be able to understand the importance of contamination and its impact on water quality, to be able to discuss the different types of contamination and to be able to compare and contrast how different contaminants derive.

#### **Slide 5 – Section break**

#### **Slide 6**

As discussed in lesson “water quality and definitions” no natural water is absolutely pure. This is because the chemical and physical characteristics of water are constantly changing through interaction with the environment and throughout the water cycle. Changes throughout the water cycle can have both positive and negative impacts in terms of water quality.

An example of where a positive change to water quality can occur through the water cycle is where particulates or dissolved solutes in water may be reduced as it percolates down to aquifers. Additionally, changes can occur where whilst water remains safe, it becomes unacceptable to consumers for aesthetic reasons such as taste, smell, or colour. However, most importantly for this lesson are the negative impacts that can occur to water quality and this will be the focus of this remainder of the lesson.

### **Slide 7**

When water becomes contaminated it can become unsafe for human consumption due to the impacts it may have on health. Contamination of water comes from 2 overall sources. The first source is from natural processes and the second source is pollution from human activities. However, sometimes there can be interlinkages arising from human-environment interactions that can further contamination.

### **Slide 8**

Whilst there are two overall general sources of contamination, the types of contamination can be split into two categories. The two categories are chemical and microbiological.

Both chemical and microbiological contamination of water supplies are global public health threats.

When contamination occurs remediation might be required to bring water quality to a level appropriate for its intended use. For more information on remediation this will be covered in lesson "Water remediation approaches for drinking water supplies".

### **Slide 9 – Section Break**

### **Slide 10**

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

### **Slide 11**

There are two sources of chemical contamination: naturally occurring chemicals and anthropogenic (caused by human activity) pollutants. It may not be possible or feasible to test water for all of the chemicals that could cause health problems. However, three especially high priority chemicals have the potential to cause serious health problems and can occur over widespread areas, these are arsenic, fluoride and nitrate. The numerous additional chemicals that can be present in water, whilst not as globally widespread, can have significant effects and these can be found discussed in the drinking water guidelines set by the World Health Organisation.

Additionally, other natural chemicals can affect the aesthetic quality of water. In some cases, this may lead to people consuming alternative water sources which potentially be less safe as they are contaminated by more serious contaminants that people are unaware of in the water.

### **Slide 12**

Groundwater sources are typically the most affected by natural chemical contamination although there are cases of seriously contaminated surface water as well.

Chemical contaminants present in the rocks and soils can be mobilized and transported in groundwater through a variety of (bio)geochemical processes. Natural chemical contaminants often affect large areas and multiple water sources, although there may be significant variation in contamination levels from source to source. Arsenic contamination levels, for example, are highly variable due to the complexity of the affected aquifers and the chemical processes involved. These

chemicals are of particular concern since the area of contamination can be quite extensive, and because contamination can go unnoticed in the absence of a testing program.

### **Slide 13**

Other non-geogenic pollutants can be chemicals released into the environment from agricultural activities, industrial processes and household waste.

Two types of pollution can occur which are point source and non-point source. Point source is from places such as factories where pollution can be pin-pointed to its source location, whilst non-point source is from pollutants such as diffuse run off from fields and emissions of chemicals into the atmosphere where the source can be spread over a larger area.

### **Slide 14 – Section Break**

### **Slide 15**

Pathogens are micro-organisms that can cause disease in humans. They fall into three major classes:

Bacteria which are single-celled organisms, typically 1 to 5 µm in size. Viruses which are protein-coated genetic material that lack many cell structures and are much smaller than bacteria – in most cases 10 to 300 nm. Finally, parasites which are single-celled organisms that invade the intestinal lining of their hosts.

### **Slide 16**

Whilst we can class pathogens based on size like on the previous slide when thinking of water quality pathogens tend to be classed on transmission routes in the environment. The reason being that it provides an advantage as using this classification system it is easier to see what interventions are likely to reduce the incidence of different water-related diseases.

There are four main categories and these are water borne, water washed, water based and water related. These 4 categories can lead to a variety of health impacts, some overlapping where diseases can come from different transmission routes.

### **Slide 17**

Water-borne diseases are diseases caused by the ingestion of water contaminated by human or animal faeces or urine containing pathogens. Faeces are considered to be one of the most serious water contaminants affecting people's health. The main water borne disease is diarrhoeal diseases.

### **Slide 18**

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

### **Slide 19**

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

### **Slide 20**

The main source of microbiological contamination is faeces, but there are other sources.

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

The interruption of the faecal-oral cycle is the key objective of most water and sanitation programmes in developing countries.

#### **Slide 21 – Section Break**

#### **Slide 22**

A third contaminant type is radiological.

However, in comparison to microbial and chemical contamination, radiological contamination is generally less widespread. The contribution of drinking water to overall radioactive exposure for humans is very small, typically less than 5%. Nearly half of the total natural radiation exposure we receive comes from a radioactive gas, radon, which is emitted by naturally occurring uranium, thorium and radium in rocks and soil.

#### **Slide 23 – Section Break**

#### **Slide 24**

In summary there are three key points. Firstly, water quality can be affected negatively by contamination. The contamination of water can be caused both by natural processes and human actions and there are three main types of contamination which are chemical, microbiological and radiological.

#### **Slide 25 – Section Break**

#### **Slide 26**

For the learning exercise for this lesson, think about the key differences between microbial, chemical and radiological contamination. Examples of differences to think about are: What are the sources of each and what are the impacts of contaminated water? T

he 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.

#### **Slide 27 – Section Break**

#### **Slide 28**

The information for this lesson has been gained from this reference and can be used for further learning to develop on information learnt.

#### **Slide 29**

For further reading, the WHO guidelines for drinking water are suitable for finding out more about how contaminants are assessed, evaluated and shows the wide range of contaminants that exist.

#### **Slide 30**

Thank you for joining this lesson and I hope you enjoyed learning about contamination of water.