TOPIC: WATER QUALITY – IMPORTANCE AND REGULATORY SETTINGS

SUB-TOPIC: PART A: WATER QUALITY – DEFINITIONS AND IMPORTANCE

Supporting Transcript

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Slide 1 – Cover

Hello, my name is Sam Addison and welcome to this lesson on water quality. This lesson is an introductory lesson focused on defining water quality and discussing the importance of water quality.

Slide 2 – Topic/lesson

In this lesson we will have a brief introduction and discuss the objectives of the lesson. We will then have a section to introduce water and water quality, the water cycle and finally the importance of water quality. Following this, I will then show a learning exercise focused on the lesson and further resources, that you may wish to follow, to think further about the lesson.

Slide 3 – Introduction

The overall aim for this lesson is to introduce and focus on what water and water quality is, look at why water quality is so important and look at its importance within the context of sustainable development goals.

Slide 4 – Objectives

By the end of this lesson, the objective is that you are able to define water quality, able to compare various uses of water and why they may have different water quality requirements. And finally, you are able to discuss reasons why water quality is of importance.

Slide 5 – section break

Slide 6 – What is water?

The question of what water is, may appear to be a basic question, but it isn't as simple as it first may seem. Furthermore, the question is a very important one, as fully understanding what water is allows for the effective use and management of water.

Water is the name of the liquid state of H_2O. A compound of hydrogen and oxygen.

Water arguably exhibits the most complex behaviour of any known substance, even though it may seem so simple with its chemical signature of H_2O. The complex behaviour becomes especially important when water molecules (each H_2O compound) come together in large numbers. One of those behaviours is that water is an excellent solvent. A solvent being something that lots of substances can become part of in a solution with water. As water is an effective solvent it leads to water found in nature always including various dissolved substances and this has an impact on the quality of water.

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Water is a crucial part of daily life for us all. We use water for many reasons which include cooking, washing and growing food. But, perhaps the most important use of water is for drinking. Without water we would not survive, as such it means that humans are reliant on water.

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As discussed, water is an excellent solvent. So many substances become a part of a solution in water, the substances can be both beneficial to us and some can be unwanted.

Minerals and ions such as calcium play key roles in biological functions, and so the drinking of water with calcium is of a benefit. However, naturally we also find contaminants, minerals, microbes and pathogens in water that are not wanted in drinking water, as they have a negative impact on human health.

How water becomes contaminated naturally easily happens. An example would be that of rainwater. Rainwater is usually fresh and clean, but it still contains small amounts of particulates that have been blown into the air by winds. Rainwater contains tiny particles of dust and dissolved gases, such as carbon dioxide and sulfur dioxide (which is termed acid rain). This doesn't mean rainwater isn't very clean—normally only about 1/100,000th of the weight of rain comes from these substances. But put simply, rainwater isn't simply just water, it has substances within it and this is the case for all water found in nature where contamination can occur from a variety of sources. Whilst the contamination discussed may not be a major concern, contamination can increase to harmful levels, which impacts our use of water.

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Depending on the use of the water, this can change how water quality is viewed. Typically, the use that has the most stringent classification is drinking water. The reasoning behind this being that we want to protect human health as the use of water for drinking leads to its consumption by us. Whilst we may think of another use such as washing, where we still need the water to be of sufficient quality but, as we do not consume the water its quality does not need to be as stringent. The potential impacts from washing with the same water as compared to drinking the water are not as potentially dangerous.

Additionally, different uses may prioritise different water quality characteristics. An example of this is for aquatic life – fish such as bass prefer warm water whilst fish such as trout may not be able to reproduce or thrive in the same warm water and thus need cold water. So, for aquatic life the temperature of water is an important characteristic, whilst temperature in regard to drinking water is not as important.

Furthermore, often different users of water may use the same water – this can have a significant impact when the quality demands that different users require are not compatible. Additionally, a user may lower the water quality during use of the water, which has an impact on users later on.

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water quality is a term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

Thinking of water quality in regard to drinking, we know that when we drink water it is not just simply hydrogen and oxygen atoms. So, we want to know about the other substances in the water and if

these substances make the water unsafe to drink. So, the water quality is a measure of the suitability of water for drinking based on its physical, chemical, and biological characteristics.

Physical characteristics would be for example - temperature, colour, odour, turbidity and solids. Whilst Chemical would be - pH, conductivity, salinity, hardness, BOD. And Biological would include counts of specific organisms or groups of organisms.

Slide 11 – Section break

Slide 12 – Water cycle

The water cycle is a key part of water and its existence on our planet. The water cycle is a continuous moving system of interconnected parts all driven by the sun. As the sun heats surface water, such as rivers, oceans, or lakes the water evaporates into its gas form: water vapor. Wind currents transport that water vapor and eventually it condenses into clouds. In certain conditions the clouds drop rain or in a rarer conditions snow or hail, which brings the water back down to the surface of the earth. If the raindrop was to land in surface water such as the ocean, then it would simply join the mix of water.

However, if it was to land on solid ground, several different things could happen. The water could infiltrate down into the soil, eventually becoming groundwater, filling in the spaces between the soil and rock. Instead of going down into the soil, the water could move across the land in a process called runoff. Runoff, with the help of topography and gravity will eventually take it to another body of water, like a lake or river. Or, instead of becoming groundwater, runoff, or staying on the surface, that water droplet could be evaporated back into the air by the sun's heat.

From surface water to air and back again is the primary loop of the water cycle.

Slide 13 – The water cycle continued

The water cycle shows that water is constantly moving and changing through the earth system.

During this movement the water is exposed to a number of environments. This can lead to water being exposed to impurities where the water quality would decrease or it can purify the water and increase the water quality.

Where the water cycle naturally cleans the water is for example when water evaporates from lakes or the ocean, it leaves impurities behind. The same purification happens when plants transpire and water evaporates through their leaves.

However, those impurities can go back into the water if the water is exposed to pollutants for example from a factory polluting a river.

The water cycle highlights the connection of all water together. All water is part of one large system and so when water is affected in one area this can have impacts on other areas aswell.

Slide 14 – Section break

Slide 15 - SDGs

The United nations set out 17 key sustainable development goals. Water is a key area within those goals and goal 6 is focused on clean water and sanitation. Demonstrating the importance of water quality on a global scale.

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Whilst shown by the sustainable development goals, water is 1 of 17 key development goals, however, this may understate how important water truly is. As stated in the first sentence of the World Water Development Report 2015, “water is at the core of sustainable development” and as such water is strongly lined to many of the 17 sustainable development goals. Whilst water is an issue for goal 6, water also impacts on goal 2 (food security), goal 3 (human health), goal 11 (resilient cities) and goal 15 (protecting ecosystems and conserving biodiversity).

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water can have a significant effect on human health.

Whilst water is essential for life it can carry diseases or chemicals that would significantly impact the health of those who drank it. The impact on human health can be caused by both human actions and natural sources. Due to poor sanitation, hand hygiene and unsafe drinking water the WHO estimates that 829,000 people die each year from diarrhoea, whilst natural causes have led to the contamination of arsenic in groundwater in many aquifers in S/SE Asia, this has led to the exposure of millions people to being negatively affected by the water they drink on their health.

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Poor water quality can also affect ecosystems. Like how water quality can affect the health of humans the same impacts can occur to animals and plants.

An example of this would be that poor water quality can lead to algae growth in lakes which under the right conditions can lead to a depletion in oxygen levels, which can have a dramatic impact on the natural food chain and aquatic lifecycles.

Furthermore, the impacts on ecosystems does not simply remain in the ecosystems themselves but can also lead to impacts on humans. Neurotoxins from the algal blooms which we previously mentioned can move through the food chain (which impacts animals) but this can also be consumed by humans who may not have interacted with the affected water at all.

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Water quality also has an impact on social and economic situations of people.

Depending on local situations many people have to travel substantial distances to collect suitable drinking water. If nearby water is improved this can lead to people spending less time and energy collecting water, meaning that they have more time and energy to be productive in alternative ways.

Equally the impacts on human health as discussed if they are avoided then this would reduce expenditure on health as a result of reduced medical costs and allow people to remain economically productive.

Children are particularly at risk from water related diseases. If children have access to cleaner water, they should gain better health which is clearly a positive alone, but this has further benefits as it can lead to increased school attendance which has substantial effects on their lives for the future.

Slide 20 – Section break

Slide 21 – Summary

Water quality describes the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

Water quality can be intrinsically related to our health, ecosystems, educational attainment and economic productivity and the sustainable decampment goals highlight how important these impacts are.

Furthermore, our understanding of water quality has evolved over the past century with the expansion of water use requirements and the ability to measure and interpret water characteristics.

Slide 22 – Section Break

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The learning exercise for this lesson is to think further about how we use water and how the impacts how we view water quality. For the exercise, list the reasons how you may use water in a typical day for example drinking or washing with. Then think about how you use the water for each purpose and how different water characteristics may impact on each purpose.

Slide 24 – Section Break

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Here is a list of sources where the information from this lesson was sourced.

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A further resource to use is the united nations' website for water, the website provides access to lots of information about water and water quality.

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Thank you for listening to this lesson and hope you have enjoyed this introduction to water quality.