The significance of $Cu^{2+}(aq)$ for people and/or the environment.

Dissolved copper ions can have both beneficial and detrimental effects on plant life, depending on the concentration and duration of exposure.

At low concentrations, copper is an essential micronutrient required for various plant functions, including photosynthesis, respiration, and enzyme activity. Copper ions are involved in the electron transport chain in chloroplasts during photosynthesis, which converts light energy into chemical energy.

Copper ions are also involved in respiration, the process by which plants convert sugars into energy. Copper is required for the function of the enzyme cytochrome c oxidase, which is involved in the final step of the electron transport chain in mitochondria, where oxygen is used to produce ATP.

Copper is also important for the formation of lignin, a component of plant cell walls that provides structural support. Copper is involved in the synthesis of the enzyme laccase, which oxidizes monolignols to form lignin

However, at high concentrations, copper can be toxic to plants, causing damage to various cellular components and disrupting metabolic processes. The toxicity of copper to plants can result in symptoms such as stunted growth, reduced chlorophyll content, root damage, and even plant death.

Copper toxicity in plants occurs when the concentration of copper ions exceeds the plant's ability to regulate copper uptake and storage. Copper ions can displace other essential metals, such as iron and zinc, from binding sites in enzymes and proteins, leading to their inactivation and disruption of cellular processes. Overall, the effect of dissolved copper ions on plant life depends on the concentration and duration of exposure.

Copper is an essential trace element required for various biological processes, including the formation of red blood cells, connective tissue, and the synthesis of neurotransmitters. However, exposure to high levels of copper can be toxic and lead to various health problems. When copper ions enter the body, for example through polluted water, they can interact with different biomolecules, resulting in biochemical changes that can be detrimental to the organism.

Copper ions can disrupt the balance of reactive oxygen species (ROS) in the body, leading to oxidative stress. This can cause damage to various cellular components, such as lipids, proteins, and DNA. The generation and action of ROS are major contributing factors to the development of different pathologies such as cancer, diseases of the nervous system and aging.

Copper ions can also displace iron from iron-sulfur clusters in enzymes, leading to their inactivation and disrupting cellular energy metabolism.

Moreover, copper ions can interfere with the function of enzymes involved in the metabolism of neurotransmitters, leading to neurological symptoms such as tremors, convulsions, and seizures. Copper can also bind to proteins, such as albumin, and interfere with their transport in the bloodstream.

In summary, copper ion toxicity due to polluted water is a result of its ability to disrupt various biochemical processes in the body. The toxicity can manifest in different ways, including oxidative stress, disruption of energy metabolism, and neurological symptoms.

The safe level of copper ions in water is determined by regulatory agencies based on the maximum contaminant level (MCL) for copper. In the United States, the Environmental Protection Agency (EPA) has set an MCL of 1.3 milligrams per litre (mg/L) or 1300 parts per billion (ppb) for copper in drinking water.

The World Health Organization (WHO) has also established guidelines for safe levels of copper in drinking water. The WHO recommends a guideline value of 2 mg/L or 2000 ppb for copper in drinking water.

It is important to note that the safe level of copper in water may vary depending on the individual's age, health status, and other factors. For example, infants and young children are more sensitive to the effects of copper exposure than adults, and may experience health effects at lower levels of exposure.