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

Zinc ions (Zn^{2+}) in water are essential nutrients for human health and play important roles in various physiological processes in the body, such as protein synthesis, wound healing, and a functioning immune system. The recommended daily intake of zinc varies depending on age, gender, and health status. The World Health Organization (WHO) has set a provisional tolerable weekly intake (PTWI) for zinc of 25 milligrams per kilogram of body weight. Drinking water is not a major source of zinc, and the concentration of zinc in drinking water is generally low and unlikely to cause harmful effects on human health at normal exposure levels. High concentrations of zinc are not commonly found in drinking water or food and are more commonly associated with industrial exposure or ingestion of zinc-containing supplements in excessive amounts.

However, excessive exposure to zinc ions through contaminated water or other sources can have harmful effects on human health. Acute exposure to high levels of zinc can cause gastrointestinal symptoms such as nausea, vomiting, and diarrhoea and decreased appetite. High concentrations of Zn^{2+} ions in the body can cause irritation and damage to the gastrointestinal lining, by disrupting the balance of ions and water in the gut, which can lead to inflammation and damage to the cells lining the digestive tract. This damage can cause fluids to leak out of the cells and into the gut, leading to diarrhoea. Zinc ions can also stimulate the production of certain hormones, such as gastrin and cholecystokinin, which can cause the stomach to produce more acid and contract more forcefully. This can lead to irritation of the stomach lining and induce vomiting.

Ingestion of large amounts of zinc can also lead to abdominal pain, headache, and dizziness. In severe cases, zinc toxicity can lead to liver damage, anaemia, and even death. Long-term exposure to high levels of zinc can lead to more serious health effects, such as impaired immune function, reduced copper absorption, and gastrointestinal irritation. The immune system can be disrupted by high concentrations of Zn^{2+} ions in the body interfering with the function of immune cells as zinc is an essential micronutrient that is required for the normal function of immune cells such as T cells. Zinc can also interfere with the function of macrophages and neutrophils, which are responsible for engulfing and destroying invading pathogens.

Zinc toxicity in animals is primarily caused by the accumulation of excess zinc in the liver and kidneys, leading to organ damage and dysfunction. The high levels of zinc can also interfere with the activity of various enzymes, including those involved in energy metabolism, DNA synthesis, and immune function. In both animals and plants, the biochemistry of zinc toxicity involves the interference with the activity of various enzymes, proteins, and other biomolecules. Zinc can bind to sulfhydryl groups in enzymes, leading to inhibition or activation of their activity. Sulfhydryl groups play an important role in catalysis and stabilisation of the enzyme structure. They can form disulfide bonds (-S-S-) with other sulfhydryl groups in the enzyme or in other proteins, which can help to stabilize the protein structure.

Zn^{2+} ions can also affect the balance of other essential nutrients, interfering with the absorption of other essential nutrients, leading to deficiencies in nutrients such as iron and calcium and copper, leading to health problems.

In plants, high levels of zinc exposure can cause symptoms such as leaf chlorosis, stunted growth, and reduced yields. Zinc toxicity in plants is primarily caused by the accumulation of excess zinc in the roots, leading to impaired nutrient uptake and transport. This can lead to deficiencies in other essential nutrients such as iron, magnesium, and phosphorus, which can increase the symptoms of zinc toxicity. Zinc toxicity in plants can also affect various processes, including photosynthesis, respiration, and protein synthesis. Zinc ions can interfere with the activity of enzymes involved in these processes, leading to reduced efficiency and impaired plant growth. Zinc toxicity can also affect the structure and function of cell membranes, leading to impaired nutrient transport and water uptake. Overall, too much zinc can negatively impact plant growth and health.