Summary of Essential Inorganic Elements

*Element**	*Best food source*	*RDA (1989)***	*ODA****	*Principal functions*	*Major deficiency symptoms*
Sodium (Na^+)	Table salt, salty foods, baking soda, baking powder	500 mg‡		Acid-base balance, water balance, CO_2 transport, cell membrane permeability, muscle activity	Dehydration, acidosis
Potassium (K^+)	Vegetables, fruits, whole grains, meat, milk, legumes	2000 mg‡		Acid-base balance, water balance, CO_2 transport, membrane transport, neuro-muscular activity	Acidosis, renal damage, cardiac arrest
Calcium (Ca^{++})	Milk, milk products, bone meal, dark green leaf vegetables	1200 mg	800–1500 mg	Formation of bones, teeth; blood clotting; cell membrane permeability; neuromuscular activity	Rickets (child), poor growth; osteoporosis (adult); muscle cramps
Phosphorus (PO_4)	Milk, milk products, egg yolk, meat, whole grains, legumes, nuts	1200 mg	800–1500 mg	Formation of bones, teeth; constituent of buffers; constituent of metabolic intermediates, nucleoproteins, phospholipids, phosphoproteins; constituent of enzymes	Osteomalacia (rare); renal rickets; cardiac arrhythmia
Chloride (CL^-)	Animal foods, table salt	750 mg‡		Electrolyte, osmotic balance; gastric acid; acid-base balance	Hypochloremic alkalosis (pernicious vomiting)
Magnesium (Mg^{++})	Chlorophyll, nuts, legumes, whole grains	350 mg male; 280 mg female	400–700 mg	Constituent of bones, teeth; decreases neuromuscular sensitivity; enzyme cofactor	Muscular tremor; confusion; vasodilatation
Iron (Fe^{++} or Fe^{+++})	Liver, meats, egg yolk, green leafy vegetables, whole grains	10 mg male; 15 mg female	10–30 mg	Constituent of hemoglobin, myoglobin, catalase, cytochromes; enzyme cofactor	Microcytic-hypochromic anemia
Iodine (I^-)	Seafoods, iodized salt	150 mcg	250–350 mcg	Constituent of thyroxin; regulator of cellular oxidation	Goiter (hypothyroidism) cretinism
Fluoride (F^-)	Seafoods, some drinking water	1.5–4 mg‡ (1ppm in drinking water)		Constituent of tooth enamel; strengthens bones and teeth	Dental caries; osteoporosis
Zinc (Zn^{++})	Liver, pancreas, shellfish, most animal tissues, wheat germ, legumes	15 mg	15–35 mg	Constituent of insulin, carbonic anhydrase, lactic dehydrogenase, alcohol dehydrogenase, and other enzymes	Anemia; stunted growth; hypogonadism in male; decreased protein synthesis and wound healing; lack of taste
Copper (Cu^{++})	Liver, kidney, egg yolk, whole grains, legumes	1.5–3 mg‡	2–3 mg	Formation of hemoglobin; constituent of 11 oxidase enzymes	Anemia; aneurysms: CNS lesions
Manganese (Mn^{++})	Liver, kidney, wheat germ, legumes, nuts	2–5 mg‡		Cofactor for number of enzymes; synthesis of mucopolysaccharides	In animals – sterility, weakness
Cobalt (Co^{++})	Vitamin B12 in animal proteins	Not estab.		Constituent of vitamin B12	Anemia
Chromium (Cr^{+++})	Liver, animal and plant tissue, brewer's yeast	0.05–0.2 mg‡	0.1–0.2 mg	Necessary for glucose utilization; possible cofactor of insulin	Unknown; deficiency in diabetes claimed; decreased glucose tolerance in rats; possible relation to cardiovascular disease
Selenium (Se)	Liver, kidney, heart, whole grains, vegetables (varies with Se in soil)	70 mcg	100–200 mcg	Constituent of glutathione peroxidase; inhibits lipid peroxidation	Liver necrosis and muscular dystrophy in animals; cardiomyopathy in humans
Molybdenum (Mo)	Liver, kidney, whole grains, legumes, leafy green vegetables	75–250 mcg‡	250–1000 mcg	Constituent of xanthine oxidase, aldehyde oxidase	Decreased growth, food consumption, and life expectancy

*The inorganic elements included are those for which evidence exists that they are essential for humans. Other elements not included but present in the human body in trace amounts for which there is fragmentary evidence for some biochemical function, include cadmium, lithium, nickel, vanadium. Other elements present in human tissues in trace amounts as incidental constituents of no known significance include Ag, Au, Al, As, Br, Pb, Rb, Si, Ti, B.

**Recommended Dietary Allowance per day, established by the Food and Nutrition Board, National Research Council, 1989. The values given are for a normal adult male, 19 to 22 years of age.

***Optimal Daily Allowance is a theoretical range based upon the author's literature research. If no range is listed, the authors felt that there was insufficient evidence to make a recommendation at this time.

‡An estimated range recommended by the Food and Nutrition Board (1989) as a safe and adequate daily intake for healthy adults

Adapted from Orten, J. and Neuhaus, O. Human Biochemistry. St. Louis: C. V. Mosby Co., 1982