

NUTRITION

MICRONUTRIENTS

VITAMINS

- Vitamins: essential for human growth, function, and development but are required in the diet as they are not made in the body or are made in inadequate amounts
- Vitamin classification
 - Fat-soluble vitamins (dissolve in fats, stored in adipose tissue, and need adequate fat for absorption)

■ Vitamin A (retinol, beta-carotene)

- Roles
 - Eye health, immune system, reproduction, and fetal development
 - Precursor for retinol (active form of vitamin A that protects the cornea and conjunctiva of the eye and allows humans to see color and in low light)
 - Carotenoids: activities similar to vitamin A; pigments give red, orange, and yellow foods their colors
 - Body converts carotenoids to vitamin A and retinol
 - Beta-carotene is the most common carotenoid
- Deficiency
 - Dry skin or rash, frequent infections, night blindness, or impaired vision
 - Xerophthalmia: dryness or thickening of the cornea
- Toxicity levels
 - Nausea, vomiting, yellowed or severely dry skin, and hair loss
 - Liver damage, excess calcium in the body, and osteoporosis
 - Toxic level of retinol
 - Adults: prolonged intake of 15,000 micrograms (50,000 IU)
 - Children and infants: 6,000 micrograms (20,000 IU)
- Food sources
 - Egg yolk, crab, halibut, whole milk products
 - Beta-carotene: carrots, green leafy vegetables, spinach, broccoli, and squash
- Athletes
 - Important for overall health and performance
 - No support for use of megadoses,!

■ Vitamin D (calciferol)

- Roles



- Absorption and metabolism of calcium and phosphorus to support hardening of bones and teeth
- Improves muscle strength, maintains immune function, and reduces the risk of osteoporosis
- Sun exposure leads to formation of vitamin D in the body
- Deficiency
 - Soft bones, bowed legs, poor teeth, skeletal deformities, and rickets
- Toxicity
 - Calcium build-up in soft tissues and irreversible kidney and cardiovascular damage
 - Toxic level: 100 mcg or more daily
- Food sources
 - Eggs, butter, cream, halibut, liver, salmon, sardines, and shrimp
- Athletes
 - No support for use of megadosing
- **Vitamin E (alpha tocopherol)**
 - Roles
 - Prevents free-radical reactions (oxidation), protects fatty acids (in cell membranes), red blood cell formation, and prostanoid synthesis
 - Deficiency
 - Infants: hemolytic anemia, dermatitis, weakness, red blood cell rupture, and fatty deposits in muscle
 - Toxicity
 - Toxic level: 1,000+ mcg
 - May interfere with vitamin K, leading to anticoagulant dysfunctions and delayed blood clotting
 - Food sources
 - Vegetable oils (soybean, corn, cottonseed, peanut, and safflower)
 - Athletes
 - May help with recovery from injury or surgery
 - For athletes in high altitudes (over 5,000 feet above sea level), maintain intake at the upper end of the acceptable range during training and competition
 - May prevent muscle cramps and counteract the higher levels of free radicals
- **Vitamin K (phyloquinone, menaquinone, menadione)**
 - Roles
 - Promotes formation of prothrombin and procoagulants (vital for blood clotting and coagulation), and involved maintenance of bone tissue
 - Is a coenzyme
 - Coenzyme: nonprotein compound required for the functioning of an enzyme



- Deficiency
 - Deficiency is rare
 - Can develop if green vegetables are restricted from the diet or drug usage that inhibits the formation of vitamin K
- Toxicity
 - No toxic side effects have been observed in adults
 - Infants: hemolytic anemia
- Food sources
 - Green leafy vegetables
- Athletes
 - Limited research on vitamin K's direct effects on performance
- **Other**
 - Zoonutrients
 - Found in animals
 - Anti-inflammatory, antimicrobial, and antihypertensive
 - Phytochemicals
 - Prevents inflammation and work as antioxidants
 - These compounds come from plants and include flavonoids
 - Flavonoids: give plants their vibrant colors and can be found in wines, berries, spices, and beans
 - Myconutrients
 - Derived from edible mushrooms
 - Anti-inflammatory and boost immune function
- Water-soluble vitamins (dissolve in water)
 - **Vitamin C (ascorbic acid)**
 - Roles
 - Coenzyme
 - Formation and maintenance of collagen, promotes healthy capillaries, gums, and teeth, aids in intestinal iron absorption, transport, and storage, provides resistance against infections, boosts immune function, and protects cells from free radical damage
 - Deficiency
 - Scurvy: weakness of connective tissue
 - Deficiency is rare in the US
 - Toxicity
 - Toxic level: more than 2 grams per day
 - Headache, increased urination, diarrhea, and nausea
 - Food sources
 - Citrus fruits, collard greens, broccoli, spinach, tomatoes, potatoes, wheat germ, and strawberries
 - Athletes
 - Endurance athletes may need higher amounts of antioxidants for optimal performance



■ Vitamin B1 (thiamine)

- Roles
 - Converted into coenzymes to aid in the breakdown of carbs and BCAAs and produces ribose (needed for normal growth and cellular function)
- Deficiency
 - Abnormalities of carbohydrate metabolism, fatigue, and loss of appetite
 - Beriberi: disease that affects the heart and the circulatory system (can cause heart failure)
 - Can be triggered by excessive alcohol consumption
- Toxicity
 - Toxicity is rare
- Food sources
 - Brewer's yeast, peas, pork, wheat germ, whole grain pasta, peanuts, beans, and organ meats
- Athletes
 - Megadoses may improve performance when taken 3–5 days before a competition (more research is needed)



■ Vitamin B2 (riboflavin)

- Roles
 - Is a coenzyme
 - Vital for the health of all tissues (particularly skin, eyes, and nerves), aids in energy production, tissue formation, maintenance of red blood cells, the metabolism of iron, and essential to the functioning of vitamins B6 and niacin
- Deficiency
 - Inflamed lips, dry skin, growth reduction, hair loss, and cataracts
- Toxicity
 - No identified unsafe amount
 - Extreme riboflavin intake can cause liver damage
- Food sources
 - Brewer's yeast, meats, poultry, fish, dairy products, nuts, enriched grain products, and green vegetables
- Athletes
 - Megadosing not recommended



■ Vitamin B3 (niacin)

- Roles
 - In the body as 2 important coenzymes: nicotinamide adenine dinucleotide (NAD) and nicotinamide adenine dinucleotide phosphate (NADP)
 - NAD and NADP are present in all cells and are in vital metabolic processes
 - Plays a role in reducing cholesterol and fatty acids in the blood
- Deficiency

- Depression, confusion, headaches, elevated body fats, and fatigue
- Pellagra: disease characterized by dermatitis, inflammation of mucous membranes, dementia, and inflamed and discolored skin
- Toxicity
 - Toxic level: amounts over 50 mg
 - Blood capillaries dilation (resulting in skin flushing, red skin, itching, warmth)
- Food sources
 - Liver, brewer's yeast, lean meats, whole grains, nuts, legumes, and potatoes
- Athletes
 - Excessive niacin intake may impair athletic performance (however, conflicting research = more research needed)



■ **Vitamin B6 (pyridoxine)**

- Roles
 - Helps metabolize amino acids, glycogen, and sphingoid bases
 - Sphingoid bases: signaling lipids found in animals and plants
 - Involved in glycogen breakdown, energy production, and tissue formation
- Deficiency
 - Depression, skin problems, poor wound healing, fatigue, and seizures
- Toxicity
 - Toxic level: more than 1,000 mg daily (100–300 mg may trigger some symptoms)
 - Skin lesions, gastrointestinal distress, lack of muscle control, numbness, and light sensitivity
- Food sources
 - Chicken, fish, kidney, liver, eggs, rice, soybeans, bananas, and walnuts
- Athletes
 - Endurance athletes should avoid high doses
 - Short-term anaerobic activity may benefit



■ **Vitamin B9 (folate)**

- Roles
 - Involved in amino acid metabolism, nucleic acid synthesis, stimulates formation of red blood cells and vitamin B12, affects tissues that grow rapidly, and supports early development of the fetal brain and spinal cord^{***}
- Deficiency
 - Anemia, birth defects, sore tongue, digestive problems, growth problems, fatigue, and poor memory
- Toxicity
 - Toxic level: above 1,000 mcg daily

- Kidney damage, seizures (anyone with epilepsy), and may block zinc absorption
- Food sources
 - Beef, lamb, pork, chicken liver, eggs, asparagus, whole wheat, dark-green leafy vegetables, salmon, and yeast
- Athletes
 - Can help speed muscle tissue repair (additional 200 mcg daily)



■ Vitamin B12 (cobalamin)

- Roles
 - Essential for energy, supports neural tissue development and function, energy metabolism, new cell growth, immune system function, and red blood cell synthesis
- Deficiency
 - Deficiency is rare
 - Fatigue, irritability, loss of appetite, constipation, headache, and sore tongue
- Toxicity
 - No adverse effects observed
- Food sources
 - Lamb, beef, herring, mackerel, pork livers, oysters, poultry, clams, and eggs
 - Vegans may need to supplement vitamin B12
- Athletes
 - Female athletes may perform better with higher levels



■ Vitamin B7 (biotin)

- Roles
 - Is a coenzyme
 - Urea formation, protein synthesis, metabolism of amino acids, glucose, and fatty acids, and helps to maintain cognitive function and healthy nails, hair, and skin
- Deficiency
 - Can be caused by excessive consumption of egg whites
 - Nausea, vomiting, depression, dry scaly dermatitis, and loss of muscle tone
- Toxicity
 - Skin rash
- Food sources
 - Liver, egg yolk, soy flour, cereals, yeast, nuts, cauliflower, milk, and legumes
- Athletes
 - No performance benefits seen with megadoses of biotin



■ Vitamin B5 (pantothenic acid)

- Roles
 - Important for many metabolic functions

- Deficiency
 - Weakness, irritability, burning feet, vomiting, and insomnia
 - Deficiency is rare
- Toxicity
 - Toxic level: over 10 to 20g daily
 - Heartburn, nausea, joint pain, and calcification of blood vessels
- Food sources
 - Potatoes, eggs, pork, beef, fish, milk, whole wheat, whole grain cereals, fruits, and vegetables
- Athletes
 - Megadosing may be beneficial for endurance athletes for short periods (7 to 14 days) before an athletic competition
 - Should only be done under physician supervision
- Vitamin-like compounds
 - **Choline**
 - Roles
 - Involved in fatty acid metabolism, liver function, and structural integrity of cell membranes
 - Used by the body to make the neurotransmitter acetylcholine
 - Is not fat soluble or water soluble
 - Deficiency
 - Interferes with the liver, memory, nerve functioning, muscle functioning and recovery, and normal growth
 - Deficiency is rare
 - Toxicity
 - Toxic level: 2 or more grams per day
 - Diarrhea, depression, and dizziness
 - Food sources
 - Lecithin, egg yolk, liver, soybeans, most fatty foods, meat, whole grains, asparagus, green beans, spinach, and wheat germ
 - Athletes
 - More research is needed
 - **Vitamin B8 (inositol)**
 - Roles
 - Fatty acid metabolism, carbohydrate metabolism, intracellular calcium mobilization, and involved in the production of neurotransmitters and glucose metabolism
 - Deficiency
 - Deficiency is rare
 - Buildup of fat in the liver and may affect nervous system function
 - Toxicity
 - Toxic level: 12+ grams of inositol per day
 - Nausea, vomiting, gas, and diarrhea



- Food sources
 - Organ meat, whole grains, fruit, milk, nuts, meats, and vegetables
- Athletes
 - No benefit from megadosing
- Dietary guidelines for vitamins
 - **More is not always better**
 - **Vitamin intake needs are different for each individual**
 - Factors affecting vitamin absorption
 - Age
 - Gender
 - Medications
 - Athletes
 - Hydration

MINERALS

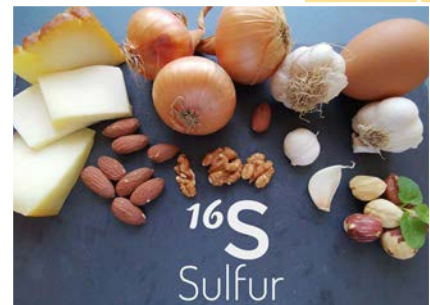
- Terms
 - Minerals: inorganic elements required for various physiological functions
 - Major minerals: minerals the body requires in relatively large amounts
 - Minor minerals: minerals the body requires in relatively small amounts
 - Electrolytes: minerals carrying an electric charge
 - **Cations carry a positive charge (more protons than electrons)**
 - **Anions carry a negative charge (more electrons than protons)**
 - Organic: compounds containing carbon
 - **Were once alive**
 - Inorganic: compounds lacking carbon
 - **Never alive**
 - Bioavailable: the amount of a substance digested and entering circulation that has an active effect in the body
- Factors affecting daily requirements for minerals
 - Activity levels
 - Body size
 - Lean body mass
 - Sweat rate
- Major minerals
 - **Calcium**
 - Roles
 - Bone building and strength, transmission of nerve impulses, maintaining a regular heartbeat, muscle contraction, cellular membrane permeability, and blood clotting
 - Functions as an enzyme cofactor
 - **Enzyme cofactor: nonprotein compound required for a protein's biological activity**
 - Dietary Reference Intakes
 - Children ages 0–13: 200–1,300 milligrams (mg) per day
 - Adult males and females: 1,000 mg per day
 - Females over the age of 50: 1,200 mg per day
 - Deficiency
 - Muscle cramping, reduced energy, rickets, and stunted growth
 - Toxicity
 - All ages: tolerable upper-intake level (UL) for calcium is 2,500 mg per day
 - Constipation, development of kidney stones, interfere with the absorption of essential minerals
 - Bone fractures, chronic gastrointestinal distress, and cardiovascular disease
 - Food sources
 - Milk, cheese, ice cream, sour cream, cottage cheese, yogurt, broccoli, and kale



- Athletes
 - Daily doses up to 1,500 mg per day have been recommended for female athletes
- **Phosphorus**
 - Roles
 - Involved in many of the same processes as calcium
 - Dietary Reference Intakes
 - Children under the age of 18 and pregnant females: 1,200 mg per day
 - Adults over the age of 19: 700 mg per day
 - Deficiency
 - Deficiency is rare
 - Poor bone formation, stunted growth, nervous system dysfunction, weakness, anorexia, and tremors
 - Can accelerate rhabdomyolysis: the breakdown of muscle tissue releasing damaging amounts of protein into the blood
 - Toxicity
 - Healthy adults: UL is 4,000 mg per day
 - can adversely affect calcium's function, hypotension, tachycardia, and tetany
 - Food sources
 - Milk, fish, eggs, and asparagus
 - Athletes
 - Adequate intake is important
- **Magnesium**
 - Roles
 - Involved in more than 300 biochemical reactions, bone growth, strength, plays a role in muscle and nerve function, activates enzymes, assists calcium and potassium uptake, helps regulate blood glucose levels, and is involved in glycolysis
 - Dietary Reference Intakes
 - Males and females under 13: 240mg per day
 - Adult females: 320mg per day (slightly more during puberty)
 - Adult males: 420mg per day
 - Deficiency
 - Deficiency is rare
 - Muscle weakness, cramps, irritability, nausea, cardiac arrhythmia, and depression
 - Toxicity
 - Over 350 mg per day
 - Depression, nausea, vomiting, hypotension, skeletal deformities, and cardiovascular disease



- Metabolic syndrome
 - Metabolic syndrome: a set of disorders such as high blood pressure, high blood sugar, high cholesterol, and excess body fat that together can increase risk of heart attack and stroke
- Food sources
 - Green vegetables, whole grains, nuts, legumes, oats, and fruit
- Athletes
 - Individuals with higher levels of activity benefit from increased magnesium intake
- Sulfur
 - Roles
 - Derived from essential amino acids: cysteine and methionine (MET)
 - Major enzyme cofactor
 - Helps the body fight free radicals and reactive oxygen species
 - Reactive oxygen species: by-products of cellular metabolism as a result of stress or immune response
 - Dietary Reference Intake
 - No established DRIs
 - Deficiency
 - Can occur with a lack of essential amino acid intake from malnourishment (lack of available food, voluntary low-calorie intake, plant-based dieting)
 - Muscle wasting: rapid loss of muscle mass and strength resulting from excess protein breakdown and reduced protein synthesis
 - Toxicity
 - No specific UL
 - Sulfur can change the acidity of blood and should be avoided by people with acidosis
 - Acidosis: condition in which blood pH is under 7.35 (this can disrupt enzyme function and reduce insulin sensitivity)
 - Food sources
 - Meat products, grain, milk, and dairy
 - Athletes
 - Endurance and strength sports require a higher protein and amino acid intake to support cellular metabolic rate and prevent muscle wasting
- Minor minerals
 - Iron
 - Roles
 - Carries oxygen throughout the body and takes the form of myoglobin for oxygen storage
 - Myoglobin: red protein carrying and storing oxygen in muscle tissue



- Mostly stored in liver hepatocytes and released when needed
 - Hepatocytes: liver cells making up 55–65% of liver mass; used for storage, bile production, metabolism, and digestion
- Dietary Reference Intake
 - Adult males and females: 8mg per day
 - Females between the ages of 18 and 50: 18mg per day
- Deficiency
 - Fatigue, restless leg syndrome, and impaired cognitive function
 - Lower immune system function, making individuals more susceptible to chronic and acute disease
- Toxicity
 - UL is 45 mg per day (for adults)
 - Increases risk for metal toxicity, intensifying aging muscle atrophy, rosacea (redness in the face), and pulmonary alveolar proteinosis (disease caused by mineral buildup in the lungs)
- Food sources
 - Red meats, poultry, fish, iron-fortified foods, liver, molasses, and nuts
- Athletes
 - Critical mineral for athletes
 - Excessive doses have not been found to be beneficial to endurance or strength athletes
- **Zinc**
 - Roles
 - Many important metabolic roles
 - Part of various metalloenzymes (play roles in human growth and development), testosterone production, DNA synthesis, cell replication, and fertility and reproduction
 - Dietary Reference Intake
 - Adult males: 11mg per day
 - Adult females: 8mg per day
 - Pregnant and lactating females: 11mg per day
 - Children under the age of 13: 3–5mg per day
 - Deficiency
 - Growth retardation, loss of appetite, delayed sexual maturation, night blindness, and impaired healing
 - Typically caused by malabsorption versus lack of intake
 - Toxicity
 - UL is 40 mg per day (for adults)
 - Reduced high-density lipoproteins, inhibited copper absorption, nausea, gastric distress, headaches, dizziness, lethargy, and fatigue
 - Food sources
 - Meat, whole-grain products, liver, eggs, seafood, herring, oysters, and oatmeal



- Athletes
 - Zinc is an essential mineral for strength and endurance athletes
 - No evidence exists for excessive doses
- Iodine
 - Roles
 - Required in all stages of life, metabolized for use in the hypothalamus, pituitary gland, thyroid gland, and circulatory system, and required for proper thyroid function
 - Dietary Reference Intake
 - Children ages 0–8: 90 micrograms (mcg) per day
 - Adult males and females: 150 mcg per day
 - Pregnant females: 220 mcg per day
 - Lactating females: 250 mcg per day
 - Deficiency
 - Thyroid gland disorders, most preventable cause of mental retardation, goiters, and goitrogens
 - Goitrogens: disrupts the production of thyroid hormones by interfering with iodine uptake in the thyroid gland
 - Often a result of malabsorption versus lack of consumption
 - Toxicity
 - UL is 1,100 mcg per day (for adults)
 - Rash, headache, metallic taste in the mouth, and hypothyroidism or goiters
 - Food sources
 - Iodized salt, seafood, cod, cod liver oil, halibut, oysters, kelp, and spinach
 - Athletes
 - Iodine loss through sweat and urine is the major concern for strength and high-intensity athletes
 - Megadoses are not necessary



- Selenium
 - Roles
 - Vital component of an antioxidant enzyme called glutathione peroxidase (protects the body from free radical damage, in particular hydroperoxides)
 - Hydroperoxides: oxygenated products of polyunsaturated fatty acids
 - Helps prevent damage to the body's tissues, cells, and molecules, plays a role in thyroid hormone production, and DNA synthesis
 - Dietary Reference Intake
 - Adults: 55 mcg per day
 - Pregnant females: 60 mcg per day
 - Lactating females: 70 mcg per day



- Deficiency
 - Hair loss, growth retardation, pancreatic problems, muscular discomfort, and muscle weakness
- Toxicity
 - UL is 400 mcg per day
 - Excessive intake: brittle fingernails, hair loss, fatigue, abdominal pain, nausea, and diarrhea
- Food sources
 - Brazil nuts, meat, seafood, kidney, and liver
- Athletes
 - Adequate daily intake is important
- **Copper**
 - Roles
 - Present in many enzymes, involved in energy production, melanin pigment synthesis, myelin formation, immune function, glucose metabolism, and cholesterol metabolism
 - Important role in connective tissues of arteries, bones, and heart and nerve signal propagation in the brain and spinal cord
 - Nearly half of the copper in the human body is stored in the skeleton and muscle tissue (large proportion in the kidneys and heart as well)
 - Dietary Reference Intake
 - Adults: 900 mcg per day
 - Children under 13 years: about 450 mcg per day
 - Pregnant females: 1,000 mcg per day
 - Lactating females: 1,300 mcg per day
 - Deficiency
 - Anemia, bone abnormalities, defects in skin pigmentation, reproductive failure, and reduced iron uptake and absorption
 - Toxicity
 - UL is 10 mg per day (for adults)
 - Food sources
 - Organ meats (especially liver), nuts and seeds, seafood, and cocoa
 - Athletes
 - No research to support higher doses
- **Manganese**
 - Roles
 - Required for cellular energy production and aids in bone and connective tissue formation
 - Dietary Reference Intake
 - Adult males: 2.3 mg per day
 - Adult females: 1.8 mg per day
 - Pregnant females: 2 mg per day
 - Lactating females: 2.6 mg per day



- Toxicity
 - UL is 11 mg per day (for adults)
- Food sources
 - Brussels sprouts, spinach, peas, turnip greens, and wheat germ
- Athletes
 - Daily adequate intake is important
- **Chromium**
 - Roles
 - Cofactor for insulin and metabolism of nucleic acids (DNA and RNA)
 - Supplements have shown to decrease body fat % and increase lean body mass
 - Dietary Reference Intake
 - Adult females: 20–25 mcg per day
 - Adult males: 30–35 mcg per day (with lower ranges suggested for adults over 50 years of age)
 - Pregnant females: 30 mcg per day
 - Lactating females: 45 mcg per day
 - Deficiency
 - Deficiency is rare
 - Uptake can be reduced when nutrition plan is high in simple sugars
 - Toxicity
 - UL has not been established
 - Excessive intake: renal failure
 - Food sources
 - Meats, mushrooms, liver, whole-grain bread, brewer's yeast, and black pepper
 - Athletes
 - Large doses not recommended for athletes
- **Molybdenum**
 - Role
 - Trace mineral
 - Energy production, nitrogen metabolism, and uric acid formation
 - Dietary Reference Intake
 - Adult males and females: 45 mcg per day
 - Pregnant and lactating females: 50 mcg per day
 - Deficiency
 - Deficiency is rare
 - Toxicity
 - UL is 2,000 mcg per day (2 mg per day) in adults over the age of 19
 - Excessive intake: gout, retarded growth, and a reduction of copper uptake and absorption



- Food sources
 - Grains, nuts, and soy
- Athletes
 - Intake over the DRI has not shown to produce higher levels of athletic performance

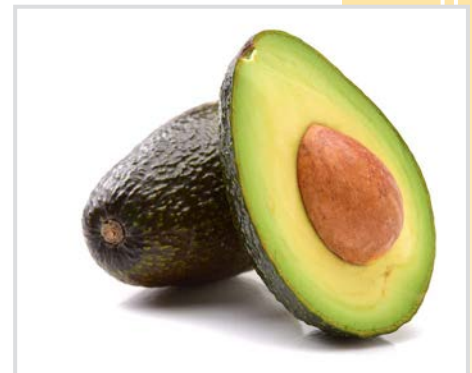
■ Fluoride

- Roles
 - Oral health and increased bone integrity
- Dietary Reference Intake
 - Adult males: 4 mg per day
 - Adult females: 3 mg per day
 - Pregnant and lactating females: 3 mg per day
- Deficiency
 - Increased tooth decay and possible osteoporosis
- Toxicity
 - UL is 7 mg per day
 - Excessive intake: severe gastric upset, nausea and vomiting, weakness, and renal failure
- Food sources
 - Fluoridated water, beverages, and tea
- Athlete
 - No evidence that exercise affects fluoride uptake or use in the human body



■ Boron

- Role
 - Trace mineral
 - Bone growth, tissue healing, inflammation, and the body's use of estrogen, testosterone, and several other vitamins
- Dietary Reference Intake
 - DRI has not been established
- Deficiency
 - Deficiency has not been observed
- Toxicity
 - No UL exists
- Food sources
 - Avocado, raisins and grapes, lentils, and nuts
- Athletes
 - No direct benefits with a higher intake



■ Electrolytes

- Roles
 - Balances fluids in the body between cells and the bloodstream
- Dietary Reference Intake
 - There are no established DRIs for the 3 major electrolytes (sodium, chloride, and potassium): safe minimum intake has been determined
 - Sodium: 500 mg per day, with 2,000–3,000 mg being on the high end
 - Chloride (often combined with sodium): 42 mg per day
 - Potassium: 1,600–2,000 mg per day (in the US)
- Deficiency
 - Happens during severe hydration
 - Dizziness, fainting, heavy sweating, confusion, and reduced physical coordination
- Toxicity
 - Sodium and chloride: hypertension, fluid balance problems, and edema
 - Potassium: 18 grams or more can cause acute hyperkalemia (can lead to cardiac arrest and prove fatal)
- Food sources
 - All foods
- Athletes
 - Long distance, endurance athletes need to focus on water, carbohydrates, and then electrolytes