## Fat Soluble Vitamins

<table>
<thead>
<tr>
<th>Vitamin/Mineral</th>
<th>Function</th>
<th>Food Sources</th>
<th>Deficiency Symptom/Disease</th>
<th>Toxicity</th>
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</table>
| Vitamin A       | • Vision (night/color)  
| Beta Carotene   | • Mucous Membranes  
|                 | • Immune Function  
|                 | • Bone and Tooth Growth | **Retinol:** fortified milk prod., Eggs, liver (preformed)  
|                 | **Beta Carotene:** dark green and yellow fruits/vegetables (provitamin A) | • Night Blindness  
|                 |                     | • Bone Growth Cessation  
|                 |                     | • Anemia  
|                 |                     | • Depressed immune function | • Dry, itchy, skin  
|                 |                     | • CNS abnormalities  
|                 |                     | • Bone pain, headaches  
|                 |                     | • Fetal deformities (Acutane) |
| Vitamin D       | • Bone mineralization and maintenance of serum calcium levels  
|                 | • Acts as hormone, Calcitriol | Fatty fish, fortified milk, eggs, butter, liver, fortified cereals, sunlight | • Rickets (weak and bowed bones)  
|                 |                     | • Osteomalacia (adult form of rickets) | • Overabsorption of calcium into soft tissues  
|                 |                     |                         | • Toxic at 5X RDA  
|                 |                     |                         | • Should not consume >200-400 IU/day |
| Vitamin E       | • Antioxidant  
|                 | • Improve vit A absorption if vit intake is low  
|                 | • Reduce platelet aggregartion and LDL oxidation  
|                 | • Detoxify compounds such as free radicals | Plant oil  
|                 |                     | Green leafy vegetables  
|                 |                     | Margarine  
|                 |                     | Oat  
|                 |                     | Wheat Germ  
|                 |                     | Nuts | • Breakdown of RBC | • Relatively nontoxic  
|                 |                     |                         | • >500 mg/day nausea, weakness, headaches, diarrhea, fatigue |
| Vitamin K       | • Blood clotting – produces prothrombin | Dark green leafy vegetables  
|                 |                     | Liver | • Rare – generally caused by lack of “healthy” bacteria in the gut which makes vit K – generally due to antibiotic overuse | • Anemia  
<p>|                 |                     |                     |                         | • Jaundice |</p>
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| Thiamin (B1)   | • Coenzyme for metabolic reactions  
• Essential for normal growth, appetite, digestion, nerves | • Pork products  
• Sunflower seeds  
• Whole grains  
• Green bean  
• Organ meats  
• Peanuts  
• Dried Beans | • Beriberi | • Common in populations where large amounts of polished rice are consumed  
• Long term intake of highly refined foods  
• Decreased by cooking in alkaline solutions  
• Alcoholism | • Rarely toxic as high levels will be excreted in the urine |
| Riboflavin (B2)| • Coenzyme for metabolic reactions | • Liver  
• Milk Products  
• Oysters  
• Dark green leafy vegetables | • Cheilosis – cracking and fissures in the corners of the mouth | • Inadequate milk consumption  
• Alcoholism  
• Sensitive to light – store in opaque containers | • Rare |
| Niacin         | • Coenzyme for metabolic reactions  
• **Useful to lower cholesterol by lowered VLDL and LDL and increased HDL | • Chicken  
• Fish  
• Lean beef  
• Yeast  
• Peanuts  
• Can be made from a.a. tryptophan | • Pellagra – causes the 3 D’s – dermatitis, dementia, diarrhea | • Diet high in corn without adequate protein  
• Severe malnutrition | • Skin flushing at high levels  
• GI distress  
• Elevated liver enzymes  
• Worsen blood glucose in diabetics |
| Pyridoxine (B6)| • Assist in carb, protein and lipid metabolism  
• Transamination  
• Immune System  
• Neurotransmitter | • Protein rich foods  
• Bananas  
• Cantaloupe  
• Broccoli  
• Spinach | • Vague symptoms: Depression, vomiting, decreased immune function | • Alcoholism  
• Smoking | • Irreversible nerve damage  
• Do not consume >50 mg/day |
## Water Soluble Vitamins

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| Folacin        | • Coenzyme  
• DNA metabolism  
• Prevent neural tube defects  
• Affects growth and repair of tissues and cells  
• Increase homocystine levels (heart risk)  
• Macrocytic cells  
• Elderly  
• Alcoholics  
• Pregnant women | • Dark green vegetables  
• Fortified grains |  |  | None – macrocytes return to normal level – caution as can be masked with B12 |
| Cobalamin (B12) | • Working is closely related with folate  
• Maintains nerve fiber sheaths  
• Bone cell activity  
• Binds with intrinsic factor in the stomach to activate  
• Elderly with poor absorption  
• Chronic use of antacids  
• Lack of intrinsic factor  
• Prolonged inadequate intake | • Meat products  
• Fortified soy milk | • Pernicious anemia (macrocytic cells)  
• Folate supplement will mask vitamin B12 deficiency (does not stop the nerve damage) |  | None reported |
| Vitamin C      | • Cofactor in reactions  
• Antioxidant  
• Reduce oxidative stress  
• Scurvy  
• Gum bleeding  
• Smokers  
• May obscure some medical tests  
• Kidney stones  
• Increased iron absorption – may act as proxidant | • Citrus fruits  
• Bell Peppers  
• Broccoli  
• Cantaloupe  
• Strawberries  
• Potatoes |  |  |  |
## Major Minerals

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| Sodium         | • Retains water in extracellular fluid  
• Regulates plasma volume  
• Nerve Conduction | • Table Salt  
• Processed Foods | • Rare  
• Muscle cramps  
• Mental apathy  
• Loss of appetite | | • Edema  
• Acute hypertension |
| Potassium      | • Maintain fluid and electrolyte balance  
• Nerve transmission  
• Muscle contraction | • Milk  
• Meats  
• Beans  
• Whole Grains  
• Fruits/Vegetables | • Loss of appetite  
• Muscle cramps  
• Confusion  
• Irregular heart beats  
• Mental apathy | • Use of diuretics | • Irregular heart beats in individuals with kidney failure |
| Calcium        | • Bones  
• Blood: muscle contraction  
• Blood coagulation  
• Active enzymes  
• Stimulate hormones | • Milk products  
• Dark Green Vegetables  
• Fish with bones  
• Fortified products | • Stunted growth  
• Osteomalacia (with vitamin D def.)  
• Osteoporosis | | |
| Phosphorus     | • Component of enzymes  
• ATP production  
• Cell membranes | • Protein sources  
• Milk products  
• Nuts  
• Legumes  
• Cereals and grains | • Weakness  
• Bone pain | • Long term anticonvulsant or antacid use | • Low Blood calcium levels |
| Magnesium      | • Energy metabolism – making enzymes for ATP production  
• Bone mineralization  
• Muscle contraction | • Nuts  
• Legumes  
• Whole Grains  
• Oats  
• Green vegetables  
• Chocolate and cocoa  
• Seafood | • Weakness  
• Confusion  
• Convulsions  
• Hallucination | | • Rare – comes from nonfood sources |
## Trace Minerals

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| Iron           | Hemoglobin carrying oxygen to the blood  
Myoglobin in muscles make oxygen for muscle contraction  
Absorption increased with Vitamin C | Heme Iron – Meat products  
Non heme iron – vegetables, grain, fruits, supplements  
Absorption increased with Vitamin C | Anemia  
PICA | Inadequate iron intake  
Heavy menstruation | Iron Overload – may be linked with heart disease  
Iron Poisoning – generally with supplements |
| Zinc           | Enzymes  
Immune Function  
Wound Healing  
Growth/Development | Protein rich foods  
Whole grains  
Vegetables | Growth retardation  
Poor sexual development in boys | High fiber and phytate intake | Interferes with iron and calcium absorption  
Decrease immune function |
| Iodine         | Part of thyroid hormone  
Regulate body temperature, metabolic rate, nerve and muscle function | Iodized salt  
Seafood  
Plants grown in iodine rich soil | Goiter  
Sluggishness  
Weight Gain  
Cretinism | Inadequate iodine intake (deficiency)  
Excessive fast food intake (toxicity) | Enlarged thyroid |
| Selenium       | Antioxidant | Animal products  
Foods grown in selenium rich soil | Predisposition to heart disease |  | Garlicky breath  
Digestive disorders  
Loss of hair/nails  
Skin lesions  
Nervous disorders |
| Fluoride       | Strong bones/teeth | Fluoridated water  
Tea  
Seafood | Dental caries |  | Fluorosis – mottling of teeth |
| Chromium       | Maintain glucose levels  
Carbohydrate and lipid metabolism | Liver  
Brewers yeast  
Whole Grains  
Nuts  
Cheeses | Glucose intolerance |  |  |