• **Deficiency** from inadequate intake, plus stress; inadequate absorption (high vitamin C or zinc, alkali, bypass); decreased utilization; increased loss (diarrhoea, celiac & Crohn’s disease, sprue, chelation therapy); increased requirement (premature birth, pregnancy, lactation);

• **Symptoms include:** anaemia; loss of bone & brittleness (osteoporosis); slowed growth in children; hair loss; enlarged heart, weak arteries (from elastin defect), decreased beneficial HDL cholesterol, increased total cholesterol; depigmentation of hair & skin; decreased tensile strength of skin; degeneration of nervous system, with abnormal behaviour; low body temperature (hypothermia) due to lowered thyroid function; damage to lung tissues (emphysema); reproductive failure; ulcer patients have 23% less copper in their body;

• **Increased cholesterol:** shortened red cell life span; decreased glucose tolerance; decreased glutathione activity; increased oxygen consumption of heart tissue; decreased formation of immune cells; increased liver iron; altered brain wave patterns;

• **Combined** copper & selenium deficiency is factor in development of cardiovascular disease;

• **Toxicity:** inorganic copper from old plumbing inhibits many enzymes; nausea & vomiting; Wilson’s disease accumulates copper in liver, kidneys, brain & cornea; 25 mg/day can be toxic;

• **Elevated copper** found in some cases of paranoia, schizophrenia, hyperactivity, hypertension, PMS, toxaemia of pregnancy, insomnia, senility & hypoglycaemia appear to be consequences rather than causes of these conditions;

• **Toxicity reversed by:** zinc + manganese in ratio of 20:1;

**Therapy with copper**

• 2 - 5 mg/day as usual therapeutic dose; 10 - 35 mg/day as amino acid chelate would probably be safe indefinitely; copper sulphate is potent emetic—5 to 10 mg dose results in nausea;

• May help prevent cancer (anti-oxidant function);

• May raise HDL, lower cholesterol & prevent aneurisms & rupture of arteries;

• May protect against & help diminish osteo & rheumatoid arthritis (anti-oxidant effect);

• May boost immune function;

• Given as part of balanced supplement;

• Copper bracelet worn traditionally to treat inflammatory diseases, esp. rheumatoid & osteo arthritis; results not yet confirmed by research;

**IODINE (I)**

**General:** trace element; anti-goitre (thyroid) element; “metabolic rate” element;

• Iodine content of foods reflects I content of soil and/or water:

• Healthy adult body contains about 15 - 30 mg of iodine;

• Major present source of iodine is iodized table salt; commercial foods made with non-I salt;

• **History:** iodine discovered in 1811; seaweed used to treat goitre in 1816; essentiality for humans established in 1850; iodine found in thyroid gland in 1895; cabbage found to produce goitre in rabbits in 1928; iodized salt available nationwide by 1940; thyroid hormones identified by 1953;

**Nutrition**

• **Sources:** sea weeds, esp. dulse & kelp; sea food, thyroid gland; iodized salt, food grown on iodine-rich soil;

• **Supplements:** kelp, potassium iodide, potassium gluconate, multi-mineral, multi-mineral-vitamin formulations;
Absorption from stomach, upper small intestine & throughout entire intestine;
Antagonized by: containing-containing cruciferous vegetables (cabbage, broccoli);
Storage: 75% is in the thyroid gland; also concentrated in ovarian tissue; iodine-containing hormone circulates throughout entire body; removed by salivary glands & recycled; body stores several months’ supply of iodine;
Excretion: removed through mother’s breast milk; excreted through kidneys;
Metabolism: increased need for I on diets high in cabbage, Brussels sprouts, turnips, broccoli, cauliflower; metabolism of iodine in thyroid needs vitamin B-2; copper & zinc necessary for conversion of thyroxin into active hormone (triiodothyronine);
Interactions: bromide, thiocyanate, perchlorate compete with iodine for transport;

Functions of iodine

Intimately associated with thyroid function, through its presence in the thyroid hormones thyroxin (76% iodine) & triiodothyronine — iodine-containing amino acids that control the metabolic rate of the entire body;
Stabilizes & controls virtually all biochemical reactions in the body;
Appears to control calcium & phosphorus metabolism, as well as starch metabolism;
Helps assimilate calcium, silicon, iron, chlorine, magnesium, manganese & other elements;
Regulates growth, development & basal metabolic rate; essential for reproduction;
Diiodothyronine may regulate ovary functions;
Important for both physical and mental development;
Can increase metabolic rate by as much as 30% for 6 days by a single dose;
Increases oxygen uptake & body temperature, heat loss & loss of body tissue;
Helps metabolize excess fats;
Necessary for protein synthesis;
Necessary to convert carotene into vitamin A;
Improves absorption from intestine of carbohydrates needed for energy;
Helps provide the metabolic energy necessary for detoxifying metabolic & environmental toxins in the tissues throughout the body;
Enhances performance of all glands & organs in the body;

Quantities

Measurement: micrograms;
Optimum: (SONA) not yet set;
Individual optimum needs to be determined for each individual case;
Minimum: (DRI) set at 150 µg/day;
Less than RDA: rare in affluent countries, because of use of iodized salt; common around the world;
Deficiency from iodine-deficient food supply; may result from salt-restricted diet used to treat high blood pressure; diet high in commercially processed foods (non-iodine salt);
Symptoms include: lowered metabolic rate, improper cell growth & differentiation, impaired mental processes, mental retardation, deafness; lowered vitality; inability to think clearly; low resistance to infections; loss of control of mouth (drooling); defective teeth, slow development of sexual organs; impotence, sterility; cold hands & feet; hypoglycaemia;
Deficiency of iodine linked to breast cancer; oestrogen in absence of iodine speeds abnormal, precancerous breast cell growth (dysphasia);
Goitre: swollen neck from enlargement of thyroid gland; fatigue, susceptibility to colds, gain weight easily; deficiency during pregnancy: cretinism in the newborn;
- **Toxicity**: less than 2,000 mg of elemental iodine can be fatal; more than a few mg/day may lead to acne; more than 50 mg/day may cause reversible inflammation of salivary (parotid & submaxillary) glands;
- **Symptoms** include metallic taste & sores in mouth, swollen salivary glands, diarrhoea & vomiting;

**Therapy with Iodine**
- Usual therapeutic dose is 100 - 1,000 mg/day;
- Alleviates symptoms of deficiency, including goitre;
- Has been used to relieve pain and soreness associated with fibrocystic breasts, that may be a symptom of iodine deficiency;
- Diiodothyronine, plus magnesium, copper & manganese relieves sore & heavy breasts & normalizes vaginal mucus; may also help keep cholesterol from forming, keep skin unwrinkled & keep breasts soft;
- 100 mg/day of iodine as potassium iodide for 7 to 14 days can protect from thyroid cancer due to uptake of radioactive iodine from nuclear fallout, by saturating thyroid tissue;
- Used in mucus-loosening (mucolytic) agents available by prescription;
- Externally, used to disinfect non-treated country water; excellent external antiseptic for wounds;

**IRON (Fe)**

**General** trace mineral; blood mineral; oxygen carrier; backbone of energy production;
- Adult body contains 4 to 5 grams, roughly the amount in a small nail;
- Oxygen-carrying pigment of red blood cells (haemoglobin) accounts for 50% of body iron;
- Very old in evolution; probably first metal associated with protein, at beginning of oxygen-using (aerobic) life forms;
- **History**: symptoms of iron deficiency anaemia described by Egyptian physicians in 1500 B.C.; recognized as part of body tissues in 1713; use of iron to treat “chlorosis” (iron-deficiency anaemia) in humans described in mid-1700’s; value of iron in treating iron deficiency anaemia established in 1932;

**Nutrition**
- **Sources**: best: meats, esp. blood, liver & kidney; good: molasses, egg yolks, whole cereals, iron cooking pots, clams, fish spinach, asparagus, prunes; poor: fortified Fe in cereals is inorganic & poorly absorbed;
- **Supplements**: iron salts, acid salts, amino acid chelates, multi-mineral, multi-mineral-vitamin formulations;
- **Absorption** from upper part of small intestine; inefficient process; optimal iron absorption from animal sources is about 15%; absorption from plant sources is only about 4%; iron absorption rate governed by body’s need: an iron-anaemic person may absorb 50 - 60% of iron present in food;
- **Improved by**: acids (citric, ascorbic, hydrochloric, etc.); copper, B-complex vitamins; sufficient stomach HCl; protein; vitamin E, calcium, manganese, vitamin A;
- **Antagonized by**: phytic acid; oxalic acid; tetracycline & its derivatives; antacids; tea; bran; copper deficiency; soy protein can decrease iron absorption by up to 92%;
- **Storage**: 50% in red blood cells; remainder stored in blood serum, liver, spleen, bone marrow (site of red blood cell formation) and muscles; iron is stored in mobile depots, hollow protein shells (ferritin), each molecule of which can hold up to 4,500 iron atoms (usually less than 3,000);