Prevent oxalate kidney stones; mild diuretic;
Treat depression due to inability to convert tryptophan to neurotransmitter serotonin;
Helpful in treating allergies, arthritis, asthma, carpal tunnel syndrome;
Reverses deficiency conditions, certain kinds of anaemia, abnormalities of amino acid metabolism;
40 mg/day used to treat morning sickness (nausea & vomiting) during early pregnancy; vital during pregnancy & lactation; may relieve depression from oral contraceptives;
Improves fertility in some cases of unexplained infertility;
50 - 200 mg/day may relieve premenstrual syndrome (PMS);
Arthritic conditions may be alleviated by high doses of B-6 + cider vinegar & lecithin;
May improve glucose tolerance in some cases of diabetes mellitus or gestational diabetes;
May lessen frequency & severity of asthma attacks (wheezing, coughing, breathing difficulties);
25 - 200 mg/day may have beneficial effects in treatment of radiation sickness;
500 mg/day used to treat carpal tunnel syndrome, instead of penicillamine;
250 to 1,000 mg of pyridoxine increase dream recall without disturbing sleep patterns;
“Mauve factor” (kryptopyrrole) schizophrenics may require 250 - 3,000 mg/day of B-6 to function normally; kryptopyrrole binds B-6, producing deficiency;
B-6 + magnesium oxide prevent the recurrence of kidney stones;
Large doses of B-6 + magnesium help treat childhood “autism”;

**VITAMIN B-12 (Cobalamin, Cyanocobalamin)**

**General** water-soluble; anti-pernicious anaemia factor;

- Most complex vitamin;
- Resembles plant pigment chlorophyll & blood pigment heme, but contains cobalt instead of magnesium (plant) or iron (blood);
- Only vitamin that contains a metal;
- For absorption, requires intrinsic factor, a mucoprotein present in gastric juice of normal individuals, but absent in individuals with defective gastric secretion or genetic condition;
- Supplementation with intrinsic factor helps those unable to produce their own, but does not significantly increase B-12 absorption in normal individuals;
- **History:** found that raw liver cures pernicious anaemia in 1926 (Nobel Prize awarded in 1934); isolated in 1948; synthesized in 1973;

**Nutrition**

- **Sources:** best: fish, dairy, organ meats (esp. liver & kidney); good: eggs, meats; poor: small (insufficient) quantities are present in spirulina, sea vegetables, fermented soy products (tempeh), & other vegetarian sources;
- **Supplements:** B-12, B-complex, multi-vitamin, multi-mineral-vitamin formulations; intramuscular injections;
- **Absorption:** of conjugated cobalamin occurs in illeum of small intestine, where intrinsic factor is released; 60 - 80% of low intake absorbed; 5 - 10% of high intake absorbed; increased during pregnancy; many small doses absorbed better than few large ones;
- **Improved by:** presence of intrinsic factor; calcium, presence of vitamin C, B-6, other B-complex vitamins & hydrochloric acid;
- **Antagonized by:** alcohol, lack of HCl & intrinsic factor (hereditary or age-related); deficiency of iron, B-6 & calcium; potassium blocks absorption;
- **Transport:** to liver and through the bloodstream by several different globulin proteins;
- **Stability:** destroyed by light & alkali; over 50% is in unstable form, destroyed in processing & food preparation; remainder is in stable form; stable to acid & oxidation;
- **Storage:** mainly in liver, bone marrow, kidneys, heart, pancreas & brain; high levels in blood of healthy individuals; depleted by laxatives;
- **Excretion:** in bile, urine, saliva;
- **Metabolism:** works in conjunction with folic acid; conversion to active form of B-12 requires B2, B-3 & manganese;
- **Interactions:** anti-gout medications & anticoagulants may block absorption; aspirin & its substitutes, codeine, antibiotics, laxatives, oral contraceptives interfere with functions;

**Functions of B-12**

- Participates in physiological activities basic to growth & division of all healthy cells; especially important in rapidly dividing cells;
- Involved in synthesis of nucleic acid (DNA);
- Essential for function of several enzymes involved in amino acid & fatty acid metabolism;
- Involved in fat & carbohydrate metabolism;
- Involved in metabolism of liver, kidneys, nervous system, heart, skin, muscle & bone;
- Maintains healthy nervous tissue; keeps anti-oxidant glutathione — involved in several enzymes of carbohydrate (brain energy) metabolism — in active (reduced -SH form);
- Necessary for metabolism of iron, folic acid & glucose; helps turn folic acid into active form; aids in formation of folic acid; produces single-carbon units which folic acid transfers from one substance to another; releases folacin from methyl folacin stored in liver (B-12 deficiency produces folacin deficiency); helps folic acid to make choline;
- Together with folic acid, B-12 regulates formation of healthy red blood cells, providing methyl (CH3) groups for DNA of dividing cells; lack of CH3 prevents cell division & produces undivided giant red blood cells (megaloblasts);
- Promotes nitrogen retention & raises biological value of proteins, leading to more rapid growth per unit of food (animals); antibiotics in feeds may speed animal growth by killing bacteria that destroy B-12;
- Growth factor in underweight children, along with improvement in diet;
- Maintains fertility, normal growth & development;
- Closely related to functions of 4 amino acids (methionine-homocysteine, glycine, serine, glutamic acid), & vitamins B-5 & C; improves iron function;
- Helps bring vitamin A into tissues; helps absorb & convert carotene to vitamin A;

**Quantities**

- **Measurement:** micrograms (mcg);
- **Optimum:** (SONA) average 2 to 3 µg/day;
- **Individual** optimum must be established for each individual;
- **Minimum:** (DRI) set at 2.4µg/day;
- **Less than RDA:** 30%, according to a U.S. government survey;
- **Deficiency:** micrograms quantities of B-12 can be difficult to obtain, due to dietary deficiency; impaired absorption; lack of intrinsic factor, transfer proteins (trans-cobalamin I & II), stomach hydrochloric acid (HCl), or calcium, all of which are essential for absorption; tapeworm or bacteria in stomach & intestines; increased requirement;
• **At risk:** vegan diets provide insufficient vitamin B-12 & need to be supplemented; deficiency develops slowly in vegan adults (10+ years); vegan children (small stores of B-12 to draw on) may show deficiency 2 - 3 years after birth; HCl production decreases with age & elderly individuals require more cobalamin;

• **Symptoms include:** pernicious anaemia, characterized by inability of bone marrow to produce normal, healthy red blood cells;

• **Prolonged** pernicious anaemia can result in brain damage &/or severe neuritis, including degeneration of nerves & spinal cord;

• **Sub-clinical deficiency** may include: tenderness in legs; slow reflexes; memory loss; irritability & mood swings; red-tipped sore tongue (like B-3 deficiency, without white coating); impaired sensory perception; anaemia; fatigue, loss of appetite & constipation; laboured breathing; palpitation; headache; difficulty walking; stammering & jerking;

• **Toxicity:** injections of more than 1,000 µg/day cause no ill effects; low absorption rate suggests that oral intake of 10 times that amount will produce no adverse effects;

### Therapy with cobalamin

- Usual therapeutic doses range from 3 to 1,000 µg/day;
- Injected B-12, or large oral doses, reverse clinical & sub-clinical symptoms;
- Powerful rejuvenating & energizing effects; especially useful during periods of stress, fatigue, recovery from illness (even when B-12 normal by standard measures);
- Improves memory, reasoning ability, concentration; dispels mental disturbances, prevents mental deterioration;
- Restores appetite & vigour; helps patients recover from viral & bacterial infections;
- Effective for treating osteoarthritis, osteoporosis, bursitis & asthma;
- Protects against smoking-induced cancer (smokers have abnormally low levels of B-12 & folic acid); smoke reduces levels of B-12 & folate in lung tissue;
- 2,000 - 4,000 mcg sublingually protects against toxins & allergens, especially sulphites (food & wine additives);
- Massive oral doses or injections help people lacking intrinsic factor;
- Keeps those eating vegan or macrobiotic diets from deteriorating due to B-12 deficiency;
- Intrinsic factor can also be supplemented together with B-12;

### PANTOTHENIC ACID (Vitamin B-5)

**General:** water-soluble; widely distributed in all living things; “anti-stress” vitamin;

- Pantothenic acid can come from foods or be made by bacteria in healthy intestinal tracts;
- **History:** described in 1933; isolated in 1938; synthesized in 1940; biochemical function identified in 1947; structure elucidated in 1953;

**Nutrition**

- **Sources:** best: organ meats (liver, kidney, heart), fish, whole grains; good: eggs, beef, beans, milk, vegetables;
- **Supplements:** B-5, B-complex, multi-vitamin, multi-mineral-vitamin formulations; Royal Jelly;
- **Absorption:** takes place in the small intestine; about 50% of intake is absorbed;
- Like other water soluble nutrients, circulates freely in the blood;
- **Improved by:** folic acid aids in assimilation of B-5;
- **Antagonized by:** antibiotics;