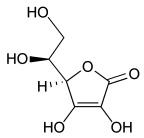
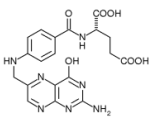
Vitamins

Vitamins

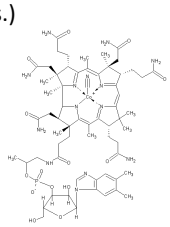
Vitamins: Vitamins are biomolecules that a living organism *requires* in trace quantities for good health. (The carbon atoms in the molecules are shown as corners in the structures.)



Vitamin C
$C_6H_8O_6$



Folic Acid
$C_{19}H_{19}N_7O_6$



Vitamin B-12
$C_{63}H_{88}CoN_{14}P$

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Vitamins

- Vitamins are recognized because of observation of the impact on an organism when a particular nutrient is not available. The list of vitamins changes as new ones are recognized.
- The line between what can be synthesized in an organism and what needs to be ingested can be blurry.
  - The overall vitamin B12 structure can only be synthesized in bacteria, but human bodies can interconvert different types of vitamin B12.
  - In some cases the vitamin can be synthesized in the body but it is highly dependent on having other metabolic needs being met. For example humans can synthesize folate, an essential vitamin, but only if there is a lot of vitamin B12 available.

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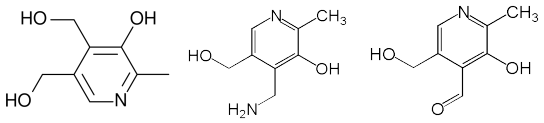
Vitamin Names

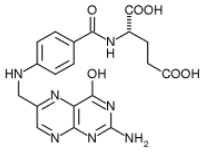
- Vitamins are classified by their biological and chemical activity, not their structure.
- A single name, such a vitamin B6, can refer to many different chemical compounds.
- In the case of vitamin B6



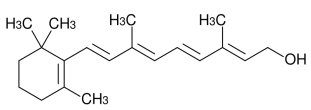
Water Soluble and Fat Soluble Vitamins

- Some vitamins are hydrophillic. These vitamins dissolve in water and they are called water soluble vitamins. The have polar functional groups (-COOH, -OH, $-NH_3^+$, $-NH^+-$, $-PO_4^{2-}$). When not used these vitamins are excreted in urine.
- Some vitamins are hydrophobic. This vitamins are principally composed of carbons and hydrogens. This vitamins are stored in body fat.

Polar and Nonpolar Bonds



Water Soluble (-COOH, -OH, $-NH_x$) Depending on the pH all of these groups may have charges.



Fat Soluble (Only 1 – OH, otherwise all C an H

TABLE 19.3 The Water-Soluble Vitamins*

VITAMIN	SIGNIFICANCE	SOURCES	REFERENCE DAILY INTAKE**	EFFECTS OF DEFICIENCY	EFFECTS OF EXCESS
Thiamine (B_1)	In coenzyme for decarboxylation reactions	Milk, meat, bread, legumes	1.5 mg	Muscle weakness, and cardiovascular problems including heart disease; causes beriberi	Low blood pressure
Riboflavin (B_2)	In coenzymes FMN and FAD	Milk, meat m	1.7 mg	Skin and mucous embrane deterioration	Itching, tingling sensations
Niacin (nicotinic acid, nicotinamide, B_3)	In coenzyme NAD^+	Meat, bread, potatoes	2.0 mg	Nervous system, gastrointestinal, skin, and mucous membrane deterioration; causes pellagra	Itching, burning sensations, blood vessel dilation, death after large dose
B_6 (pyridoxine)	In coenzyme for amino acid and lipid metabolism	Meat, legumes	2.0 mg	Retarded growth, anemia, convulsions, epithelial changes	Central nervous system alterations, perhaps fatal
Folic acid	In coenzyme for amino acid and nucleic acid metabolism	Vegetables, cereal, bread	0.4 mg	Retarded growth, anemia, gastrointestinal disorders; neural tube defects	Few noted except at massive doses
B_{12} (cobalamin)	In coenzyme for nucleic acid metabolism	Milk, meat	6 μg	Pernicious anemia	Excess red blood cells
Biotin	In coenzyme for carboxylation reactions	Eggs, meat, vegetables	0.3 mg	Fatigue, muscular pain, nausea, dermatitis	None reported
Pantothenic acid (B_5)	In coenzyme A	Milk, meat	10 mg	Retarded growth, central nervous system disturbances	None reported
C (ascorbic acid)	Coenzyme; delivers hydride ions; antioxidant	Citrus fruits, broccoli; greens	60 mg	Epithelial and mucosal deterioration, causing scurvy	Kidney stones

* *Adapted in part from Frederic H. Martini, Fundamentals of Anatomy and Physiology, 4th edition (Prentice Hall, 1998).*
** *RDI values are the basis for information on the Nutrition Facts Label included on most packaged foods. The values are based on the Recommended Dietary Allowances of 1968.*

Vitamin C Deficiency

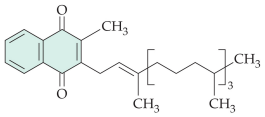
- Scurvy is the result of defects in collagen synthesis.
- This defect is due to a lack of vitamin C in the diet.
- The link between vitamin C and scurvey was recognized long before the cause was understood.

TABLE 19.4 The Fat-Soluble Vitamins*

VITAMIN	SIGNIFICANCE	SOURCES	REFERENCE DAILY INTAKE**	EFFECTS OF DEFICIENCY	EFFECTS OF EXCESS
A	Maintains epithelia; required for synthesis of visual pigments; antioxidant	Leafy green and yellow vegetables	1000 μg	Retarded growth, night blindness, deterioration of epithelial membranes	Liver damage, skin peeling, central nervous system effects (nausea, anorexia)
D	Required for normal bone growth, calcium and phosphorus absorption at gut, and retention at kidneys	Synthesized in skin exposed to sunlight	10 μg	Rickets, skeletal deterioration	Calcium deposits in many tissues, disrupting functions
E	Prevents breakdown of vitamin A and fatty acids; antioxidant	Meat, milk, vegetables	10 mg	Anemia; other problems suspected	None reported
K	Essential for liver synthesis of prothrombin and other clotting factors	Vegetables; production by intestinal bacteria	80 μg	Bleeding disorders	Liver dysfunction, jaundice

* *Adapted in part from Frederic H. Martini,* Fundamentals of Anatomy and Physiology, *4th edition (Prentice Hall, 1998).*
** *RDI values are the basis for information on the Nutrition Facts Label included on most packaged foods. The values are based on the Recommended Dietary Allowances of 1968. RDIs for fat-soluble vitamins are often reported in International Units (IU), which are defined differently for each vitamin. The values given here are approximate equivalents in mass units.*

Vitamin K



Vitamin K

- Vitamin K is important in proper blood clotting.
- It is made by bacteria in the gut, and can be obtained from leafy green vegetables (butterred?)
- Babies have guts with few bacteria, and have low blood clotting factors.
  - 2-10 cases of bleeding to this per 100,000 births
  - Vitamin K shots are required at birth in many places.
- Bone loss?, Cancer?, Alzheimers?

Toxicity and Vitamins

- Most vitamins are toxic when taken in excess.
- This is particularly true of fat soluble vitamins because they are stored in fat cells, and to are not flushed out the the body through the kidneys.
- This does not mean that water soluble vitamins are without risks. Excess Vitamin C can lead to kidney stones. Excess B12, excess red blood cells.

Minerals

- **Dietary minerals are the chemical elements required by living organisms, other than elements common in organic molecules. Though they are called minerals often what is meant are ions, such as K^+, Mg^{2+}, Fe^{3+}, I^- or PO_4^{3-}.**
- **All minerals cannot be synthesized in the organism so all of them would be considered essential.**
- **You don't usually get them from rocks but rather from vegetables and meat.**

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