Vitamins and Nutrition

Vitamin –

Coenzyme –

Cofactor –

Prosthetic group –

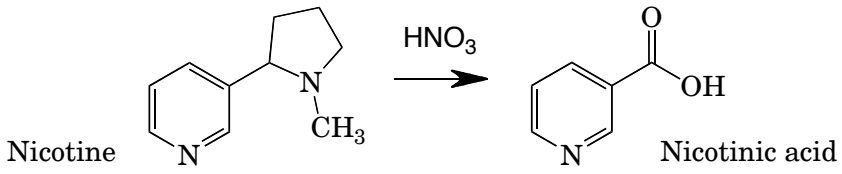
Water-Soluble Vitamins

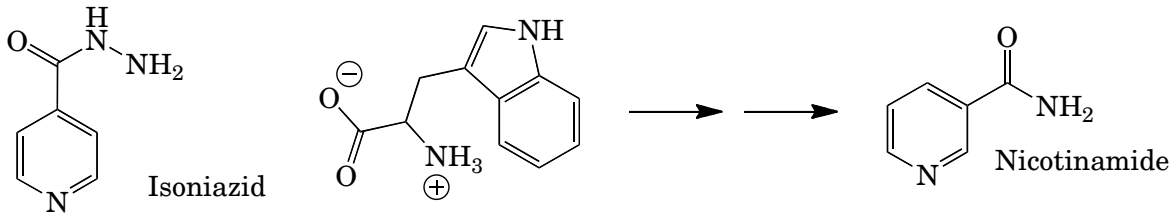
Name	Function	Deficiency
Vitamin B_1 (thiamin)	Precursor to coenzyme ***thiamin pyrophosphate***, which is required for oxidative decarboxylation reactions	Beriberi – muscle weakness, loss of reflexes, numbness, depression
Vitamin B_2 (riboflavin)	Precursor to ***FAD*** and ***FMN***, which are prosthetic groups used for redox reactions.	Not named – photophobia, proliferation of capillaries in the eye, dermatitis
Vitamin B_3 (niacin)	Precursor to ***NAD*** and ***NADP***, which are coenzymes used for redox reactions.	Pellegra – weight loss, digestive disorders, dermatitis, depression, dementia
Vitamin B_5 (Pantothenic acid)	Precursor to ***Coenzyme A***	Not named – neurological and digestive problems
Vitamin B_6 (pyridoxal and related compounds)	Precursor to ***pyridoxal phosphate***, which is a prosthetic group for amino acid metabolic enzymes and for glycogen phosphorylase	Not named – dermatitis, neuropathy, altered free amino acid levels, depression.
Vitamin B_{12} (cobalamin)	Precursor to coenzymes used for one-carbon transfer reactions	Pernicious anemia – enlarged fragile erythrocytes, neurological disorders
Folic acid	Precursor to coenzyme ***tetrahydrofolate***, which is used for one-carbon transfer reactions	Megaloblastic anemia – enlarged fragile erythrocytes, neural tube defects, neurological disorders
Biotin	Prosthetic group for several carboxylase enzymes	Not named – depression, hallucinations, muscle pain, dermatitis, immunodeficiency
Vitamin C (ascorbic acid)	Coenzyme for hydroxylase enzymes	Scurvy – defective collagen synthesis, dementia

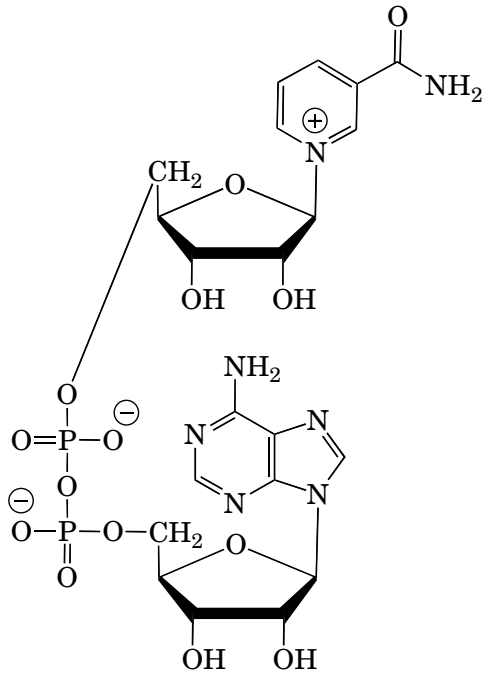
Fat-Soluble Vitamins

Name	Function	Deficiency
Vitamin A (retinol and β-carotene)	Precursor visual pigment ***retinal*** and to ***retinoic acid*** signaling molecules involved in cellular differentiation	Not named – night-blindness, blindness, developmental abnormalities, keratinization of epithelial tissues.
Vitamin D (ergocalciferol and cholecalciferol)	Precursor to ***1α, 25-dihydroxyvitamin D***, a signaling molecule involved in calcium absorption and homeostasis, and in regulation of cellular differentiation	Rickets and Osteomalacia – softening of the bones
Vitamin E (α-tocopherol)	Antioxidant, especially in erythrocytes.	Not named – anemia, and possibly other effects
Vitamin K (menadione and related compounds)	Precursor to Vitamin K coenzyme used for synthesis of γ-carboxyglutamate residues, especially in clotting factor proteins	Hemorrhagic disease of the newborn, Hemorrhagic syndrome – deficient blood clotting

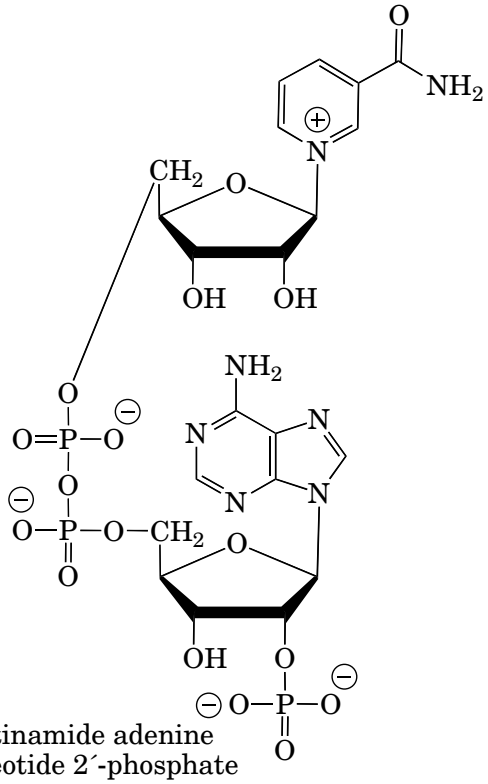
Niacin (Vitamin B_3)



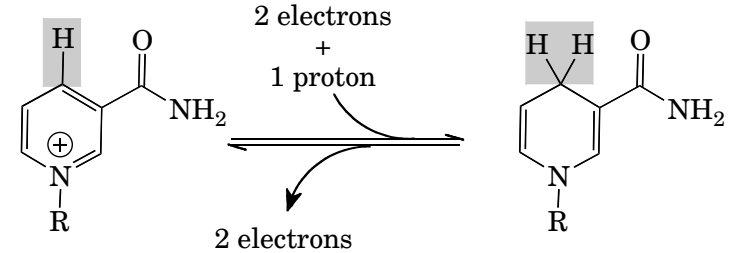




Nicotinamide adenine dinucleotide [NAD]



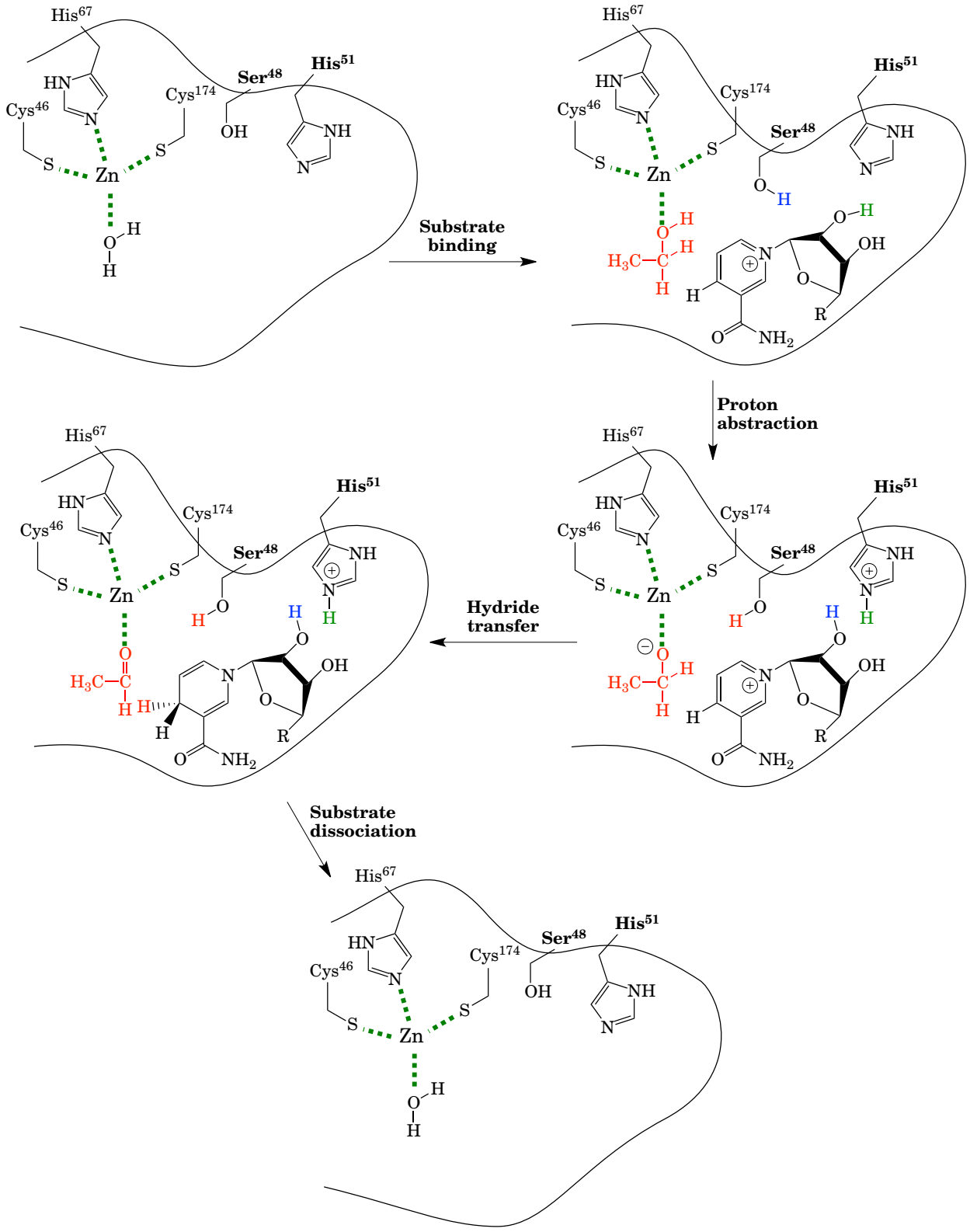
Nicotinamide adenine dinucleotide 2´-phosphate [NADP]



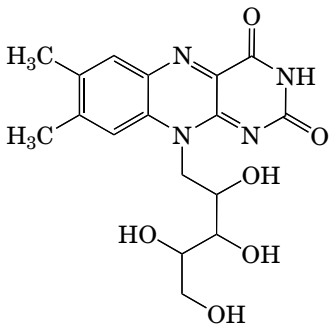
Oxidized NAD(P)

Reduced NAD(P)H

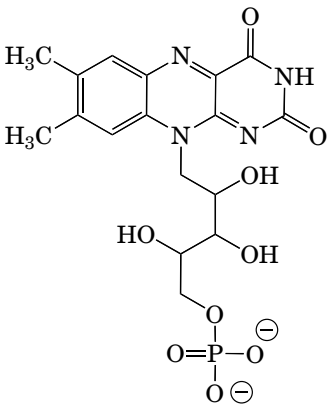
Alcohol Dehydrogenase



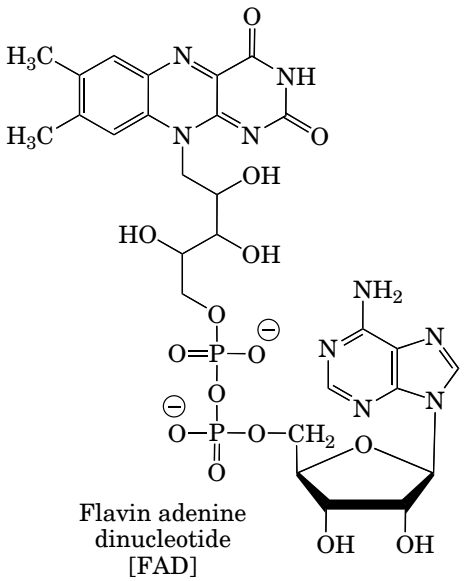
Riboflavin (Vitamin B_2)



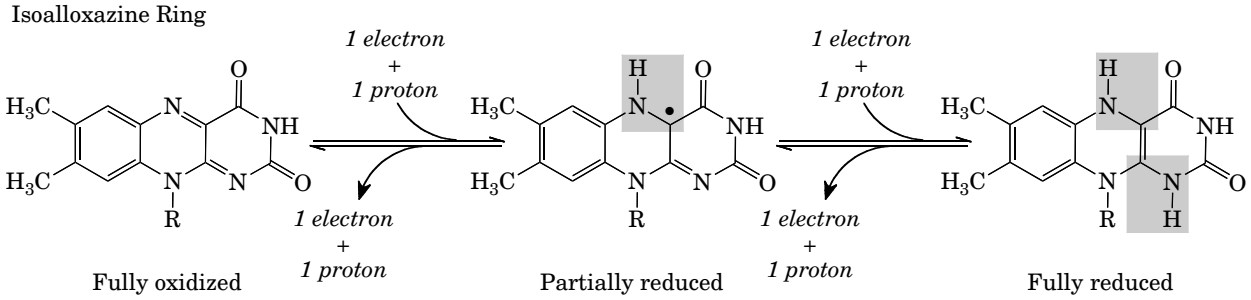
Riboflavin
(Vitamin B_2)



Flavin
mononucleotide
[FMN]



Flavin adenine
dinucleotide
[FAD]

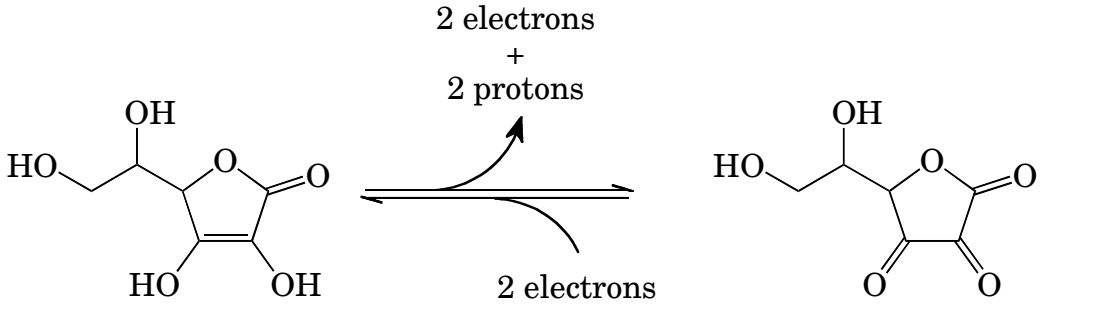


Fully oxidized

Partially reduced

Fully reduced

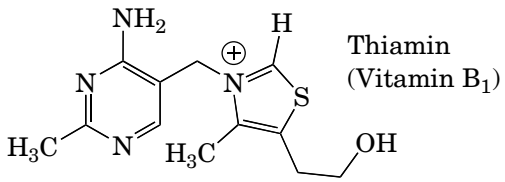
Ascorbic Acid (Vitamin C)

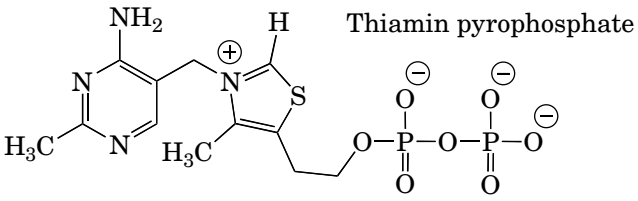


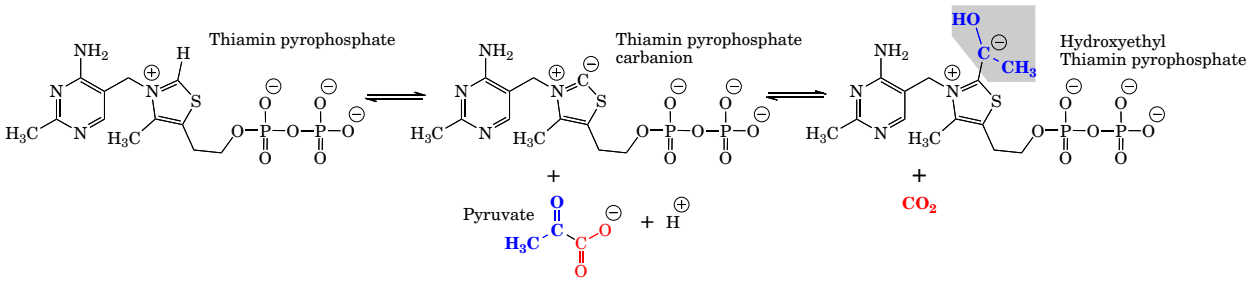
Ascorbic acid
(Vitamin C)

Dehydroascorbic acid

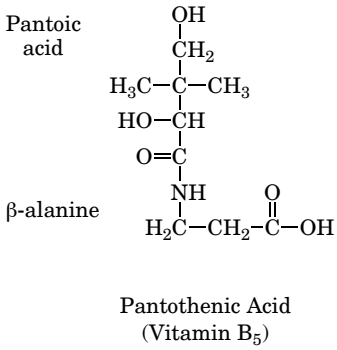
Thiamin (Vitamin B_1)

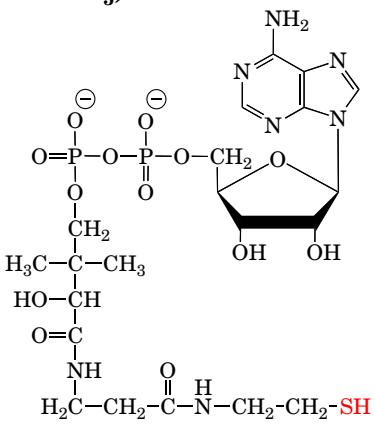


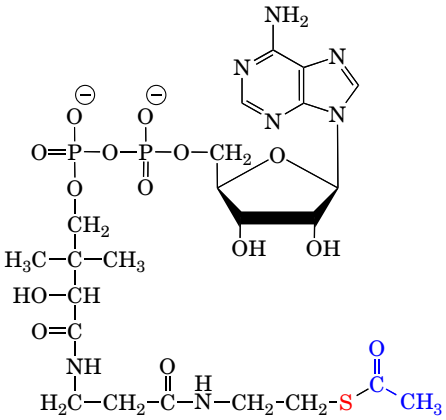




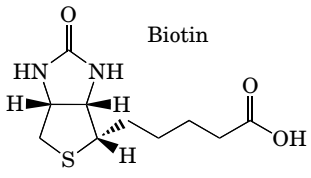
Pantothenic Acid (Vitamin B_5)

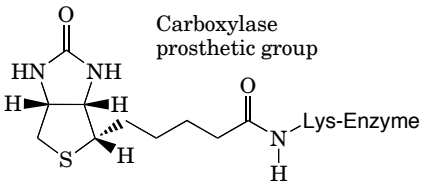


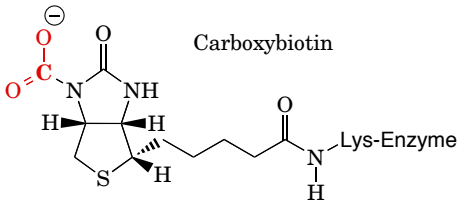




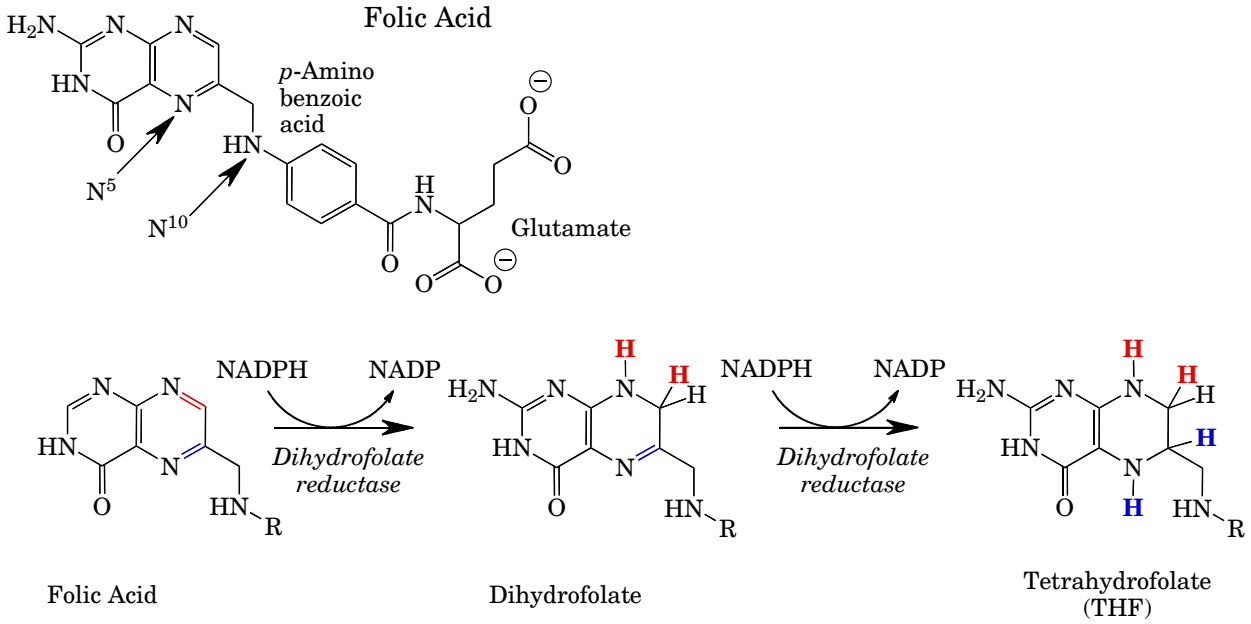
Biotin



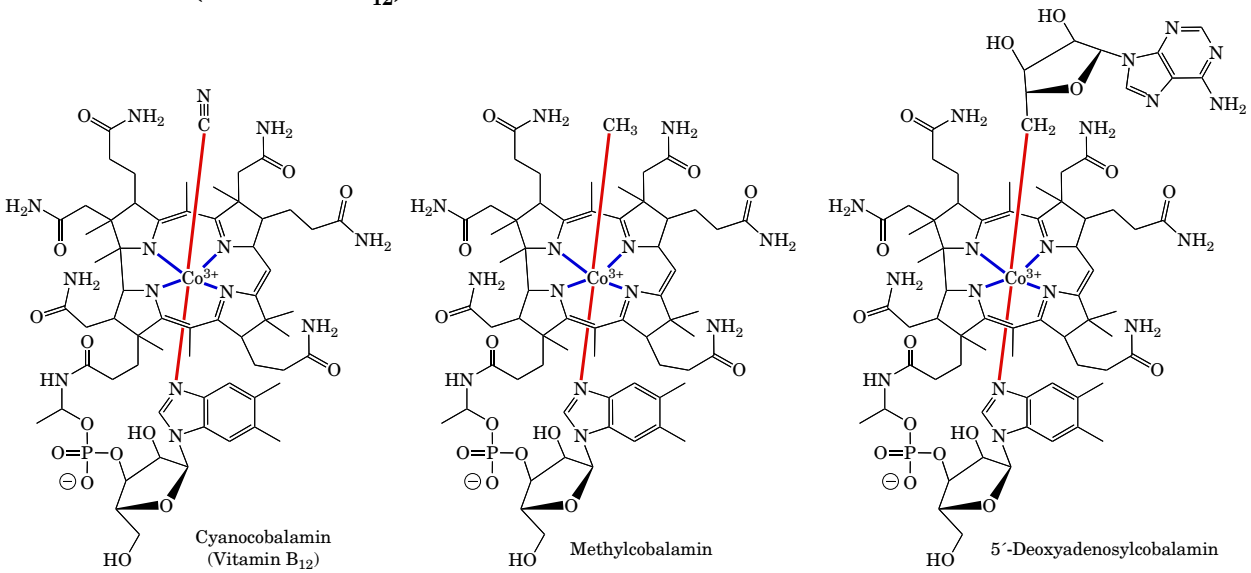




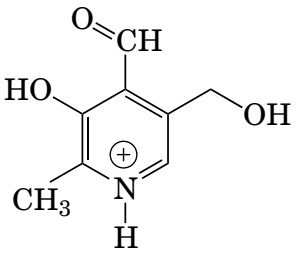
Folic Acid



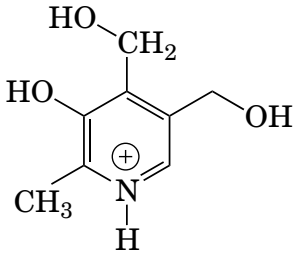
Cobalamin (Vitamin B_{12})



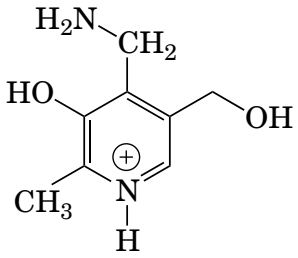
Vitamin B_6



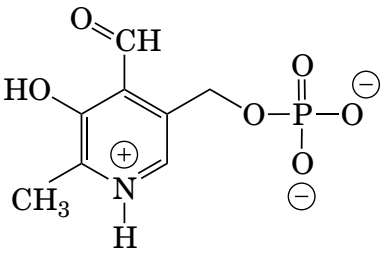
Pyridoxal



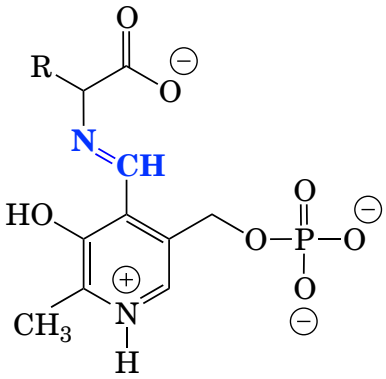
Pyridoxine



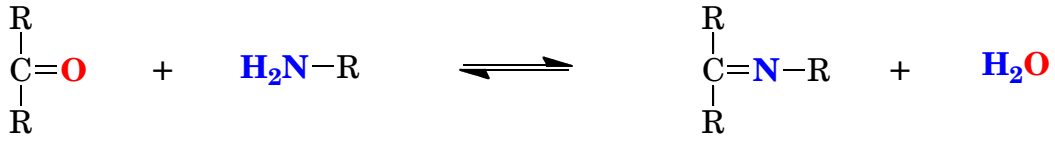
Pyridoxamine



Pyridoxal phosphate



Pyridoxal phosphate
Schiff base to α-amino acid

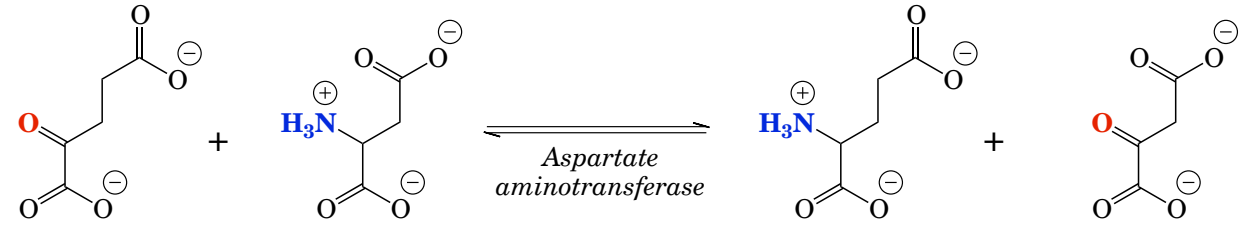


Aldehyde or ketone

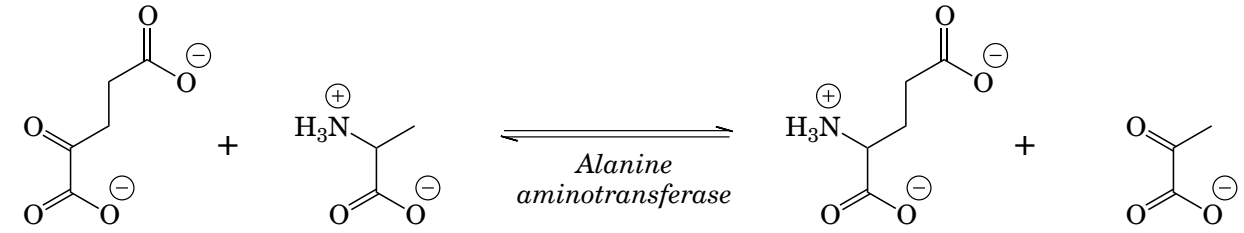
Amine

Schiff base

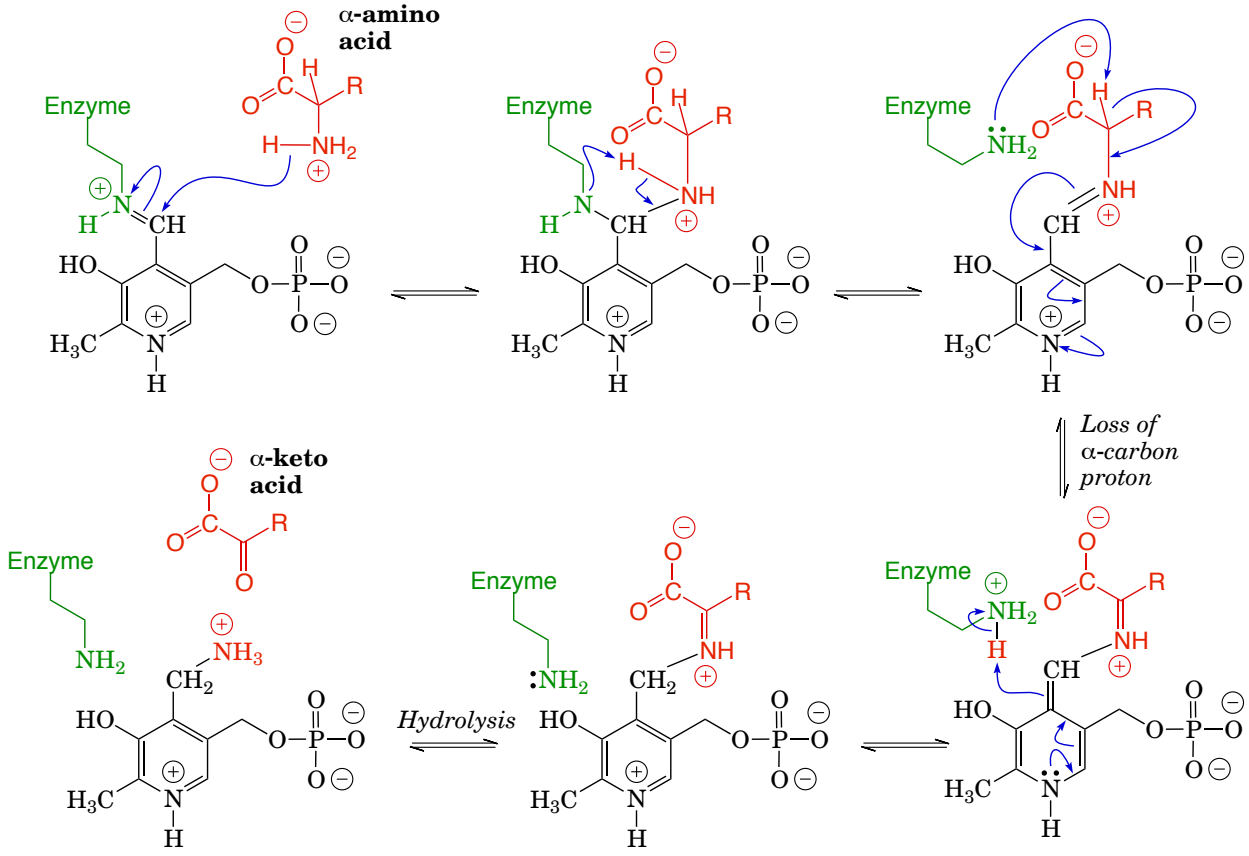
Aminotransferases



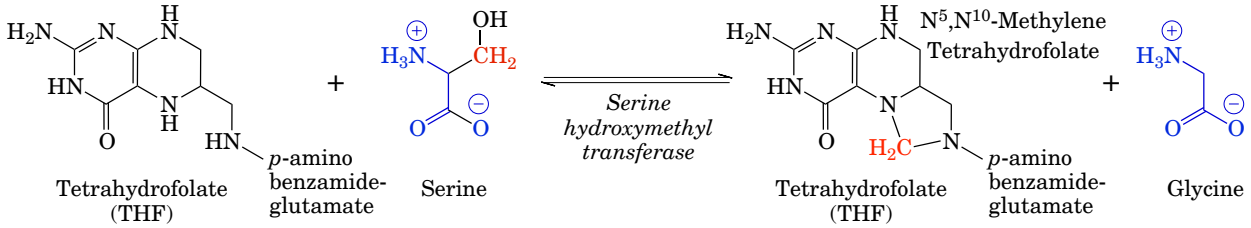
α-Ketoglutarate Aspartate Glutamate Oxaloacetate

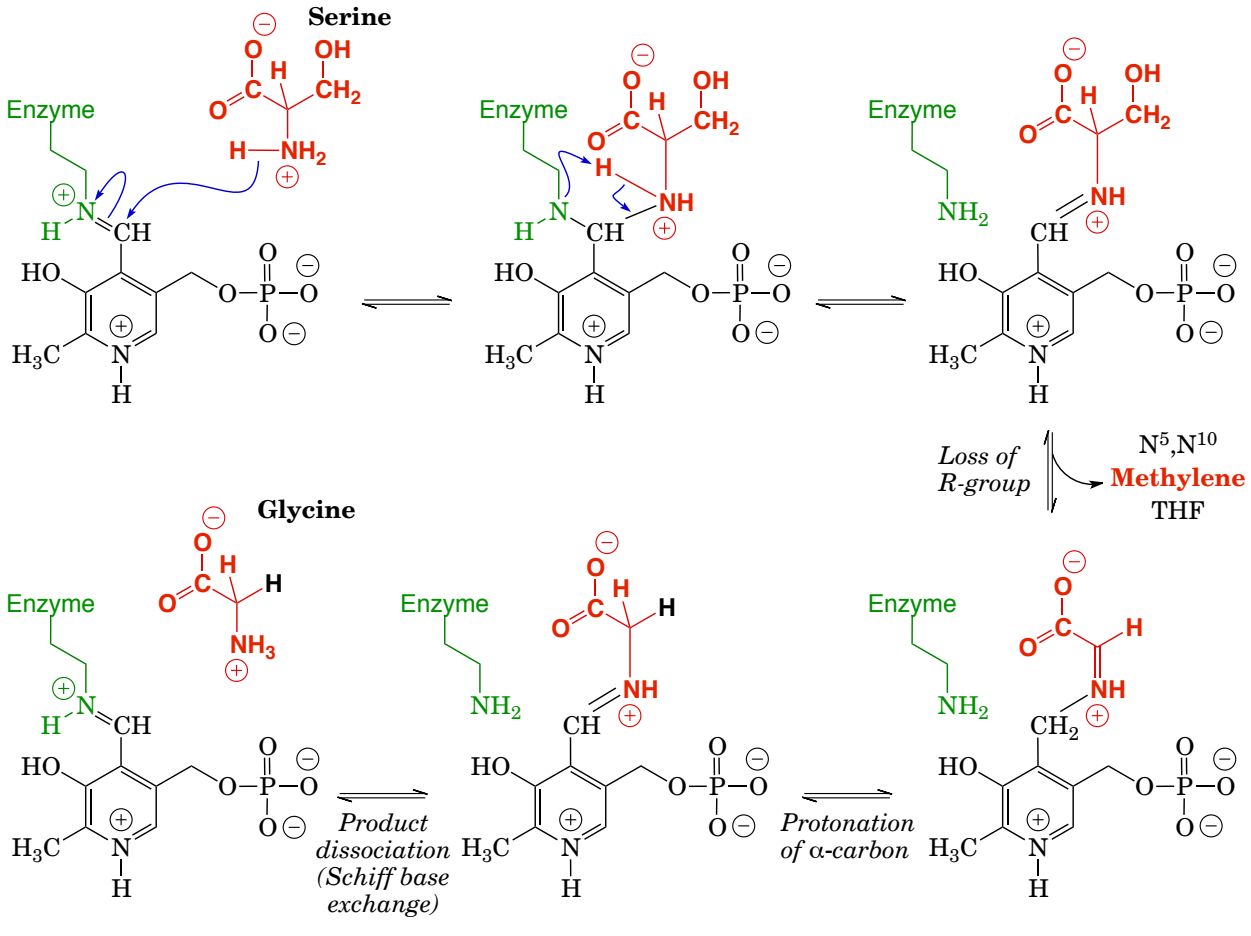


α-Ketoglutarate Alanine Glutamate Pyruvate

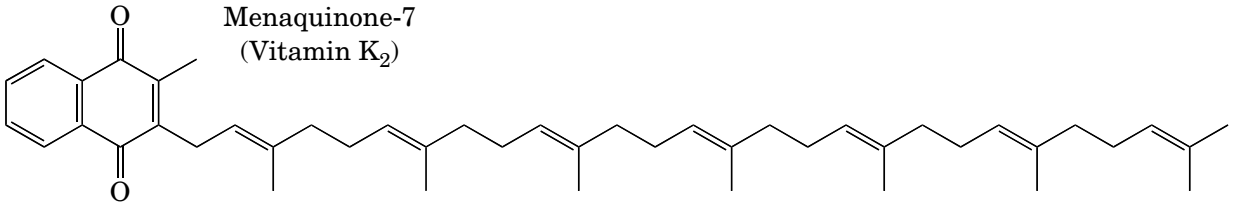


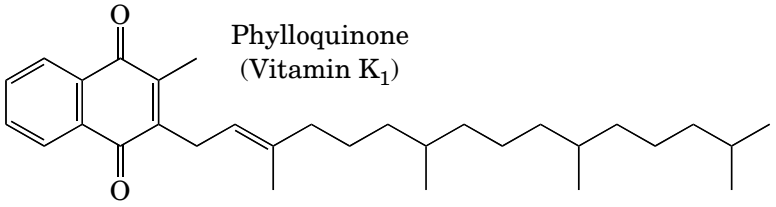
Serine Hydroxymethyl Transferase

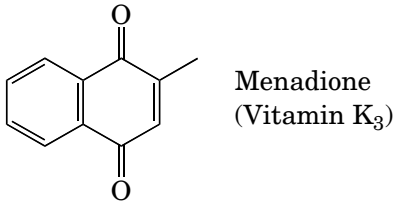


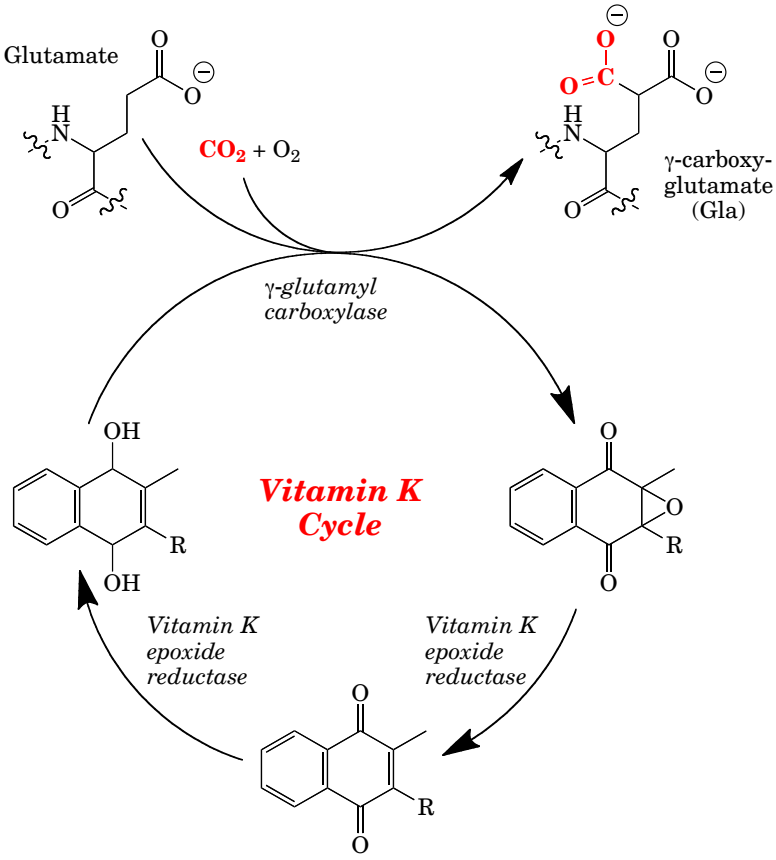


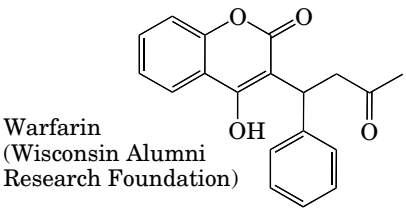
Vitamin K


Menaquinone-7
(Vitamin K_2)

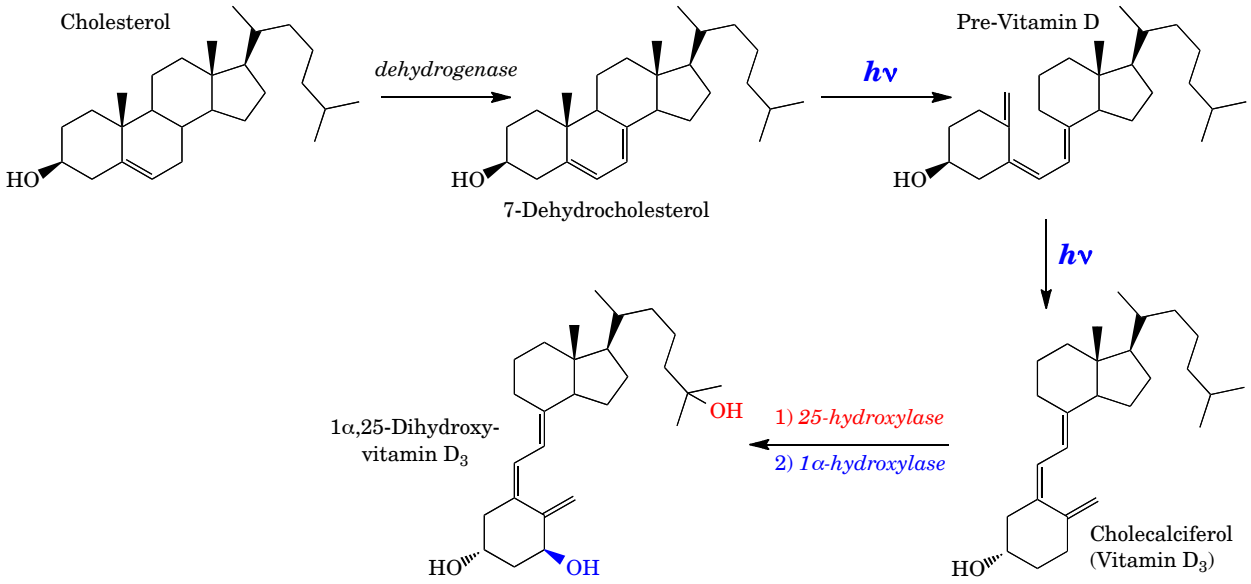

Phylloquinone
(Vitamin K_1)


Menadione
(Vitamin K_3)

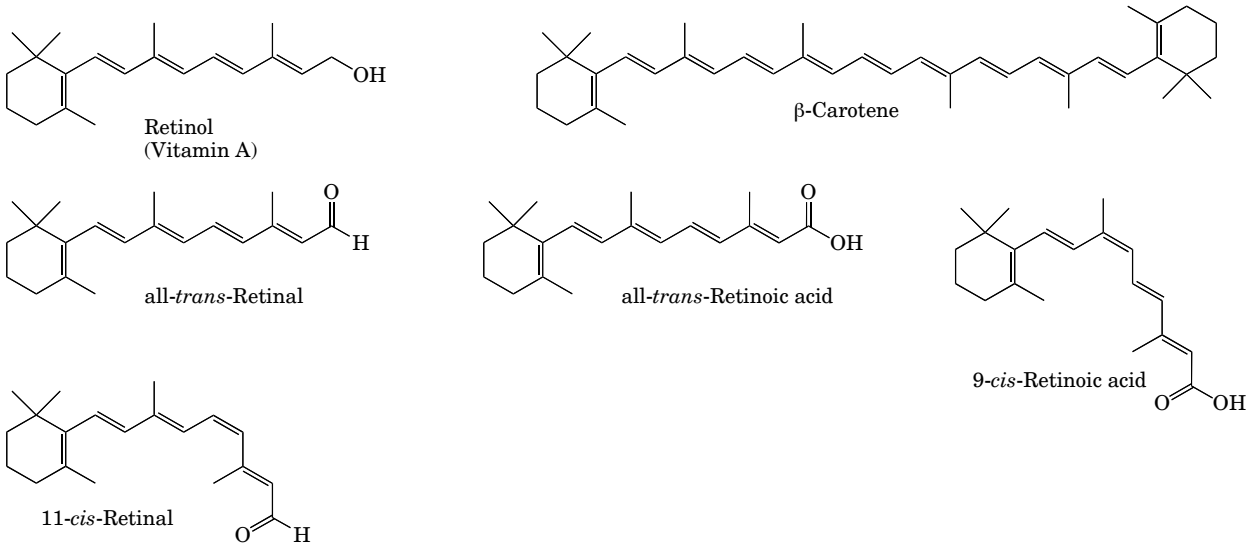

Glutamate
$CO_2 + O_2$
γ-carboxy-glutamate (Gla)
γ-glutamyl carboxylase
Vitamin K Cycle
Vitamin K epoxide reductase
Vitamin K epoxide reductase


Warfarin
(Wisconsin Alumni Research Foundation)

Vitamin D



Vitamin A



Vitamin E