Film 4

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Basic Nutrients
Energy
Hypoxia
Porphyrins
Vitamin A and D

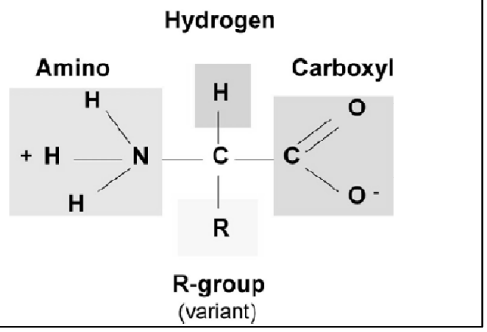
LIFE and HEALTH
ARE DEPENDANT
UPON
ADEQUATE NUTRITIONAL
INTAKE

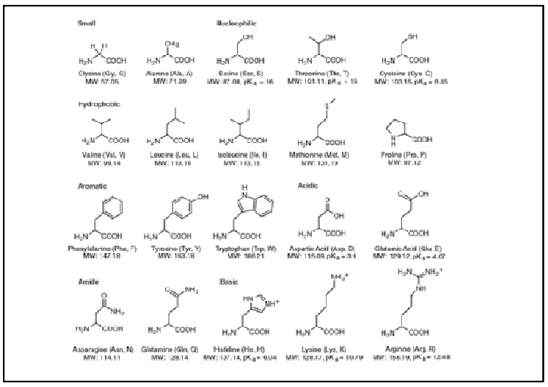
AMINO ACIDS

1. BUILD TISSUES
2. TRANSPORT MOLECULES
3. FORM ANTIBODIES
4. FORM ENZYMES
5. BUILD CHEMICAL MESSENGERS i.e. HORMONES AND NEUROTRANSMITTERS

Amino.acids are biologically important organic compounds composed of amine (-NH_2) and carboxylic acid (-COOH) functional groups, along with a side-chain specific to each amino acid. The key elements of an amino acid are carbon, hydrogen, oxygen, and nitrogen.

Amino Acid Structure





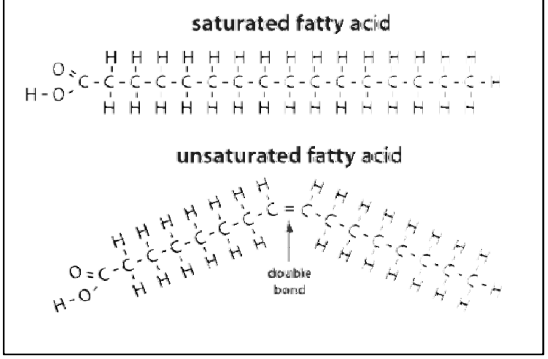
Essential			Nonessential		
Histidine	N 90%,	Hydrophobic	Alanine	N	Hydrophobic
Isoleucine	N	Hydrophobic	Arginine	+ve	Hydrophilic
Leucine	N	Hydrophobic	Asparagine	N	Hydrophilic
Lysine	+ve	Hydrophilic	Aspartic acid	–ve	Hydrophilic
Methionine	N	Hydrophobic	Cysteine	N	Hydrophobic
Phenylalanine	N	Hydrophobic	Glutamic acid	–ve	Hydrophilic
Threonine	N	Hydrophilic	Glutamine	N	Hydrophilic
Tryptophan	N	Hydrophobic	Glycine	N	Hydrophobic
Valine	N	Hydrophobic	Ornithine		
			Proline	N	Hydrophobic
			Selenocysteine		
			Serine	N	Hydrophilic
			Tyrosine	N	Hydrophilic

Left brain weakness give hydrophilic

Right brain weakness give hydrophobic

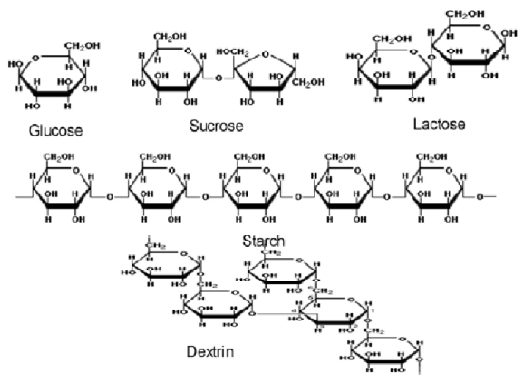
FATTY ACIDS

1. FORM CELL MEMBRANES
2. ARE SOURCES OF ENERGY
3. ARE STORES OF ENERGY
4. PROTECT ORGANS
5. ACT AS ELECTRICAL AND THERMAL INSULATORS
6. BUILD STEROID HORMONES



CARBOHYDRATES

1. Are a source of energy
2. Link with amino acids to form glycoproteins
3.. Link with fatty acids to form glycolipids.

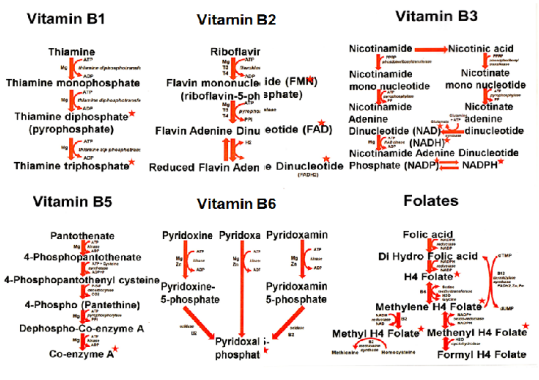


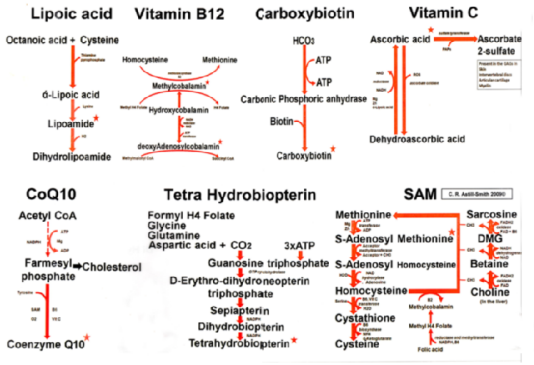
VITAMINS

1. CO-ENZYMES PRECURSORS IN SPECIFIC ENZYME PATHWAYS
2. ACT AS ANTIOXIDANTS
3. INVOLVED WITH BLOOD CLOTTING
4. PART OF CELL MEMBRANES

Co-Enzymes

- Thiamine pyrophosphate
- Thiamine triphosphate
- FMN – FMN H
- FAD - FADH2
- NAD – NADH
- NADP – NADPH
- CoA
- Pyridoxal-5-phosphate
- H4Folate
- Methenyl H4 Folate
- Methylene H4 Folate
- Methyl H4 Folate
- H4 Biopterins
- Adenosylcobalamin
- Methylcobalamin
- Biotin
- Vitamin C
- Alpha Lipoic acid
- SAM
- CoQ10





MINERALS ACT TO

1. Supply major elements and trace elements that may be lacking in the diet.
2. Act as catalysts, thus playing a major role in metabolism and cell building.
3. Regulate the permeability of cell membranes.
4. Maintain water balance and osmotic pressure between the inside and outside environment.
5. Influence the contractility of muscles.
6. Regulate the response of nerves to stimuli.

LIFE DEPENDS UPON IONIC BALANCE TO MAINTAIN HOMEOSTASIS

IONIC BALANCE DEPEND UPON ADEQUATE NUTRIENT UPTAKE FROM IONIZED MINERALS

Optimising human performance depends upon optimal ATP mitochondrial production requiring

1. **Optimal nutritional**
2. **Optimal oxygen delivery**
3. **Absence of toxins**
4. **Absence of infections**
5. **Positive emotional state**

ENERGY

Ultimately all our energy comes from the sun

DEFICITS IN ENERGY PRODUCTION

Loss of Energy, Pain and Difficulty in memory recall are the most common symptoms complained of by patients attending any health care practitioner.

There is a common link between all these symptoms.

80% energy produced goes to heat to keep us warm.

Of the remainder One third is involved with the active process of the cellular Sodium / Potassium pumps.

Another third is involved with enzymatic activity.

The final third of energy production is for contractile and non-contractile tissues such as cilia.

The daily 1500–2000 Calories recommended for a human adult are taken as a combination of oxygen and food molecules, the latter mostly carbohydrates and fats, of which glucose ($C_6H_{12}O_6$) and stearic acid ($C_{57}H_{110}O_6$) are convenient examples.

The food molecules are oxidised to carbon dioxide and water in the mitochondria

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
$C_{57}H_{110}O_6 + 81.5O_2 \rightarrow 57CO_2 + 55H_2O$

and some of the energy is used to convert ADP into ATP
$ADP + HPO_4^{2-} \rightarrow ATP + H_2O$

80% of the chemical energy in the carbohydrate or fat is converted into heat.

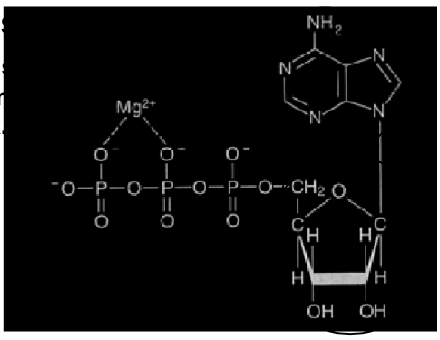
ATP is used as "energy currency", and some of the chemical energy it contains when split and reacted with water, is used for other metabolism.

(At each stage of a metabolic pathway, 80% chemical energy is converted into heat).

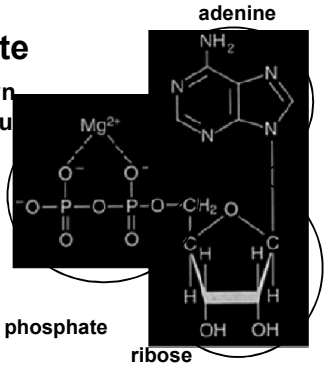
Only a tiny fraction of the original chemical energy is used for work.

Adenosine
tripho
(ATP)
the magn
complex.

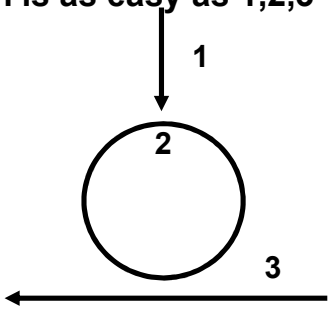
adenine



Adenosine diphosphate (ADP) shown as the magnesiu complex.



Understanding energy production is as easy as 1,2,3



Glucose

Glycolysis

1

2

Kreb's cycle

3

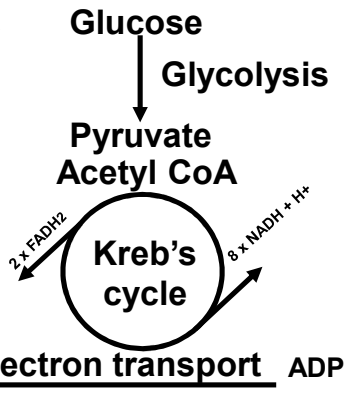
Electron transport

For every 1 molecule of Glucose 38 molecules of ATP are formed.

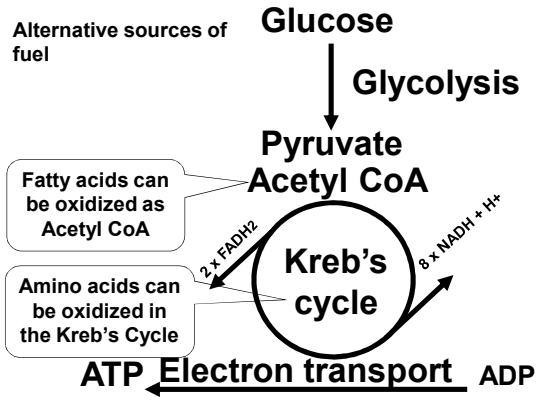
8 ATP by Glycolysis

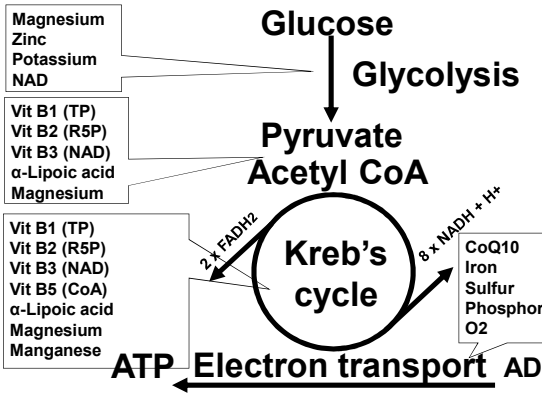
2 ATP in the Kreb's cycle

28 ATP by Electron transport

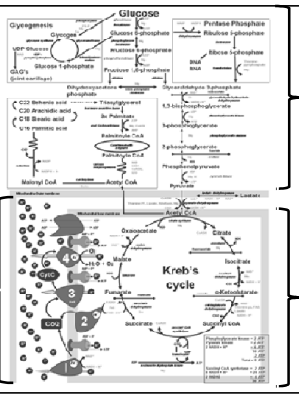


Alternative sources of fuel





Energy pathway

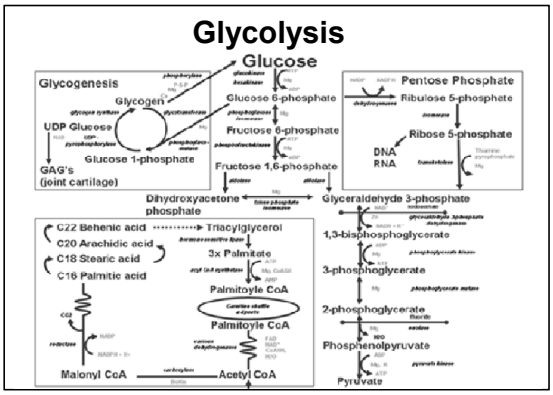


Glycolysis

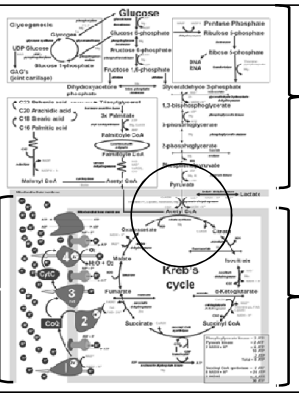
Citric Acid Cycle

Electron transport or Oxidative phos-phorylation pathway

Glycolysis



Energy pathway



Glycolysis

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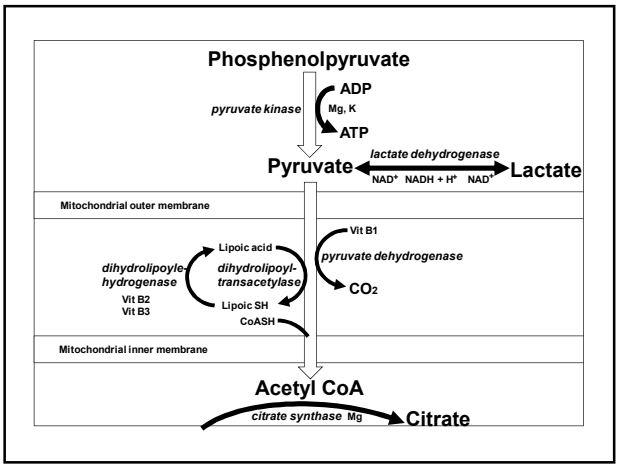
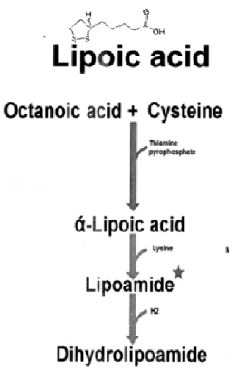
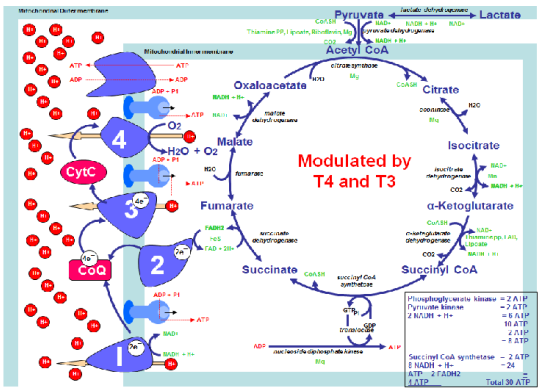
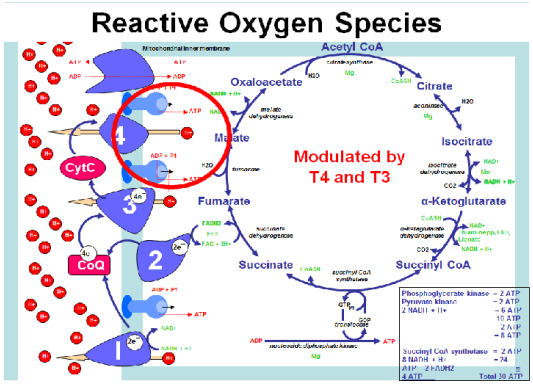
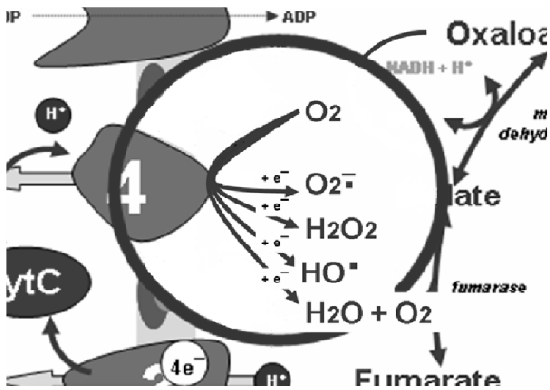


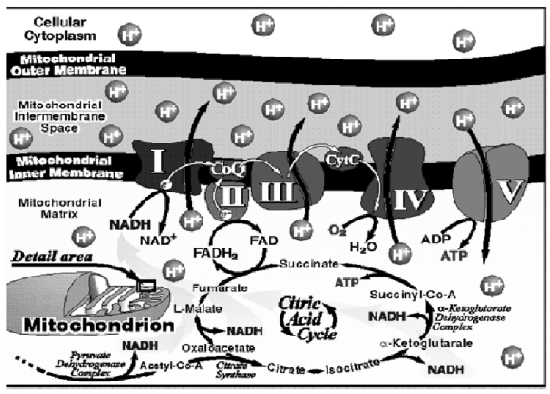
Alpha Lipoic Acid catalyses the conversion of Pyruvate to Acetyl CoA and the conversion of alpha Keto-glutarate to Succinyl CoA





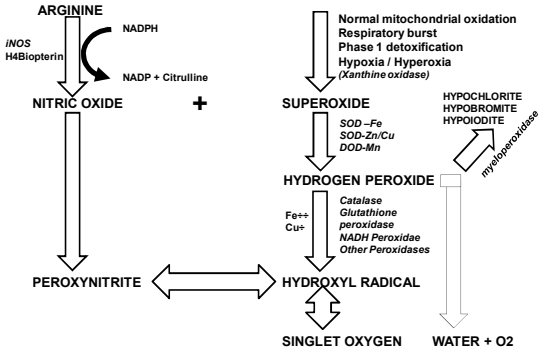

Reactive Oxygen Species
Acetyl CoA
Oxaloacetate
Citrate
Isocitrate
Malate
Fumarate
α-Ketoglutarate
Succinate
Succinyl CoA
CytC
CoQ
Modulated by
T4 and T3


ADP
Oxaloa
NADH + H+
O2
O2-
H2O2
HO
H2O + O2
fumarase
4e-
Fumarate

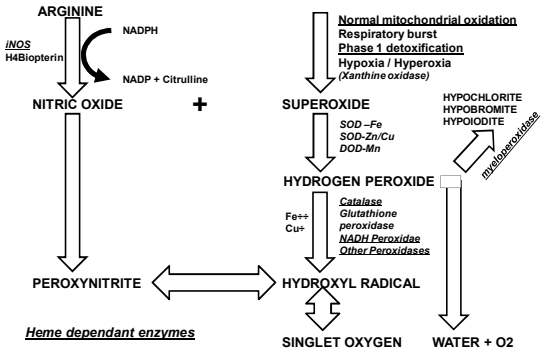

Cellular
Cytoplasm
Mitochondrial
Outer Membrane
Mitochondrial
Intermembrane
Space
Mitochondrial
Inner Membrane
Mitochondrial
Matrix
CoQ
CytC
NADH
NAD+
FAD
FADH2
Succinate
Fumarate
L-Malate
Oxaloacetate
Citrate
Isocitrate
Acetyl-Co-A
Succinyl-Co-A
α-Ketoglutarate
ATP
ADP
Detail area
Mitochondrion
Citric
Acid
Cycle

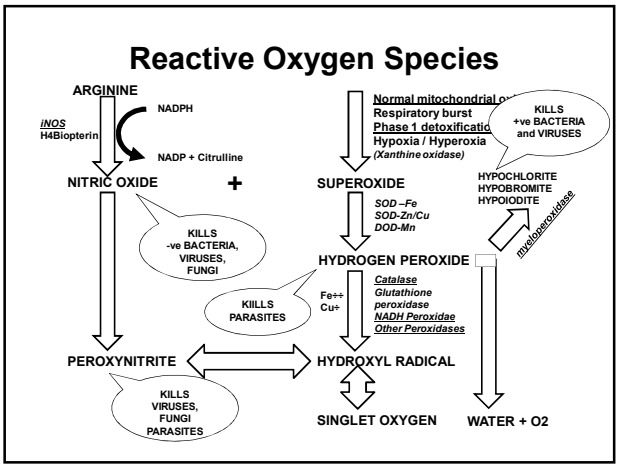
Reactive Oxygen Species

Reactive Oxygen Species



Reactive Oxygen Species





Challenging for Energy

1. **Weak muscle strengthens to ATP**
2. **Strong muscle weakens to ADP**

For Glycolysis challenge for strengthening against Pyruvate

For Krebs cycle challenge for strengthening against NADH or FADH2

Challenge against individual Krebs cycle intermediates

For Electron Transport challenge for strengthening against
Complex 1 (NADH)
Complex 11 (FADH2)
Complex 111
Complex lV (cytochrome c oxidase)

HYPOXIA

Hypoxia is a condition in which the body or a region of the body is deprived of adequate oxygen supply.

Hypoxia may be classified as either *generalized*, affecting the whole body, or *local*, affecting a region of the body.

Symptoms
Gradual onset - Light-headedness
Numbness / tingling of extremities,
Nausea and anorexia.
Tiredness
Visual deterioration
Memory loss
Feeling the cold
Degenerative changes

Symptoms
Rapid onset - ataxia, confusion / disorientation / hallucinations / behavioural change, severe headaches / reduced level of consciousness, papilloedema, breathlessness, pallor, tachycardia and pulmonary hypertension.

If hypoxia is very severe, a tissue may eventually gangrene.
Extreme pain may also be felt at or around the site.
Eventually leading to the late signs cyanosis, bradycardia / cor pulmonale and hypotension followed by death.

Because haemoglobin is a darker red when it is not bound to oxygen (deoxyhaemoglobin), as opposed to the rich red colour that it has when bound to oxygen (oxyhaemoglobin), when seen through the skin it has an increased tendency to reflect blue light back to the eye.

Hypoxia can result from a failure at any stage in the delivery of oxygen to cells. This can include decreased partial pressures of oxygen, problems with diffusion of oxygen in the lungs, insufficient available haemoglobin, problems with blood flow to the end tissue, and problems with breathing rhythm.

Functional Testing for Hypoxia

Oxygen saturation is a term referring to the concentration of oxygen in the blood. The human body requires and regulates a very precise and specific balance of oxygen in the blood. Normal blood oxygen levels in humans are considered 95-100 percent. If the level is below 90 percent, it is considered hypoxia.

Blood oxygen levels below 80 percent may compromise organ function, such as the brain and heart, and should be promptly addressed. Continued low oxygen levels may lead to respiratory or cardiac arrest.

In medicine, oxygen saturation (SO_2), commonly referred to as "sats", measures the percentage of hemoglobin binding sites in the bloodstream occupied by oxygen. At low partial pressures of oxygen, most hemoglobin is deoxygenated.

At around 90% (the value varies according to the clinical context) oxygen saturation increases according to an oxygen-hemoglobin dissociation curve and approaches 100% at partial oxygen pressures of >10 kPa.

A pulse oximeter relies on the light absorption characteristics of saturated hemoglobin to give an indication of oxygen saturation.

Functional Biochemistry Testing
i) All muscles weak on testing
ii) Single muscle weakens on repeated muscle testing (aerobic challenge)
iii) Positive eyes into distortion up and down
iv) Weak muscle strengthens to Oxygen
v) Strong muscle weakens to CO_2 and / or Xanthine oxidase

Patient Protocol for Hypoxia

From weakness patient strengthens to HYPOXIC eye position
Confirm using OXYGEN vial to strengthen
Challenge using following vials

PHOSPHOLIPIDS	HEMOGLOBIN	Co-ENZYME Q10
EPO, BSO , Borage	ALA	Co-Q10 in oil
Black cumin	PBG	
Flax ,	UPG III	
Grape seed	CPG III	
Hazelnut, Hemp	PP IX	
Macademia		
Olive, Coconut		
Peanut		
Pumpkin		
Super Omega 3		
Walnut		
WGO, Cardiolipin		

Oxygen in the air

Alveolar membrane

Red blood cell membrane

Red blood cell

Red blood cell membrane

Tissue cell membrane

Tissue cell

Tissue cell mitochondrial membrane

Tissue cell mitochondria

Oxygen transport

Oxygen into the Lungs
By volume, dry air contains
78.09% nitrogen
20.95%oxygen
0.93% argon
0.039% carbon dioxide
and small amounts of other gases.
Air also contains a variable amount of water vapor, on average around 1%.

At sea level the partial pressure of oxygen (pO2) in the lungs = 21% of atmospheric pressure 760mm Hg = 160mm Hg.
At 16000ft with atmospheric pressure at 400mm Hg pO2 = 82mm Hg

Henry's Law of Solution states that the quantity of a gas going into simple solution at constant temperature is proportional to the pressure. The solubilities of oxygen, carbon dioxide and nitrogen are in the ratio of 2:50:1

Movement of gases is always from the region of high tension to a region of low tension.
Oxygen will thus pass from the lung alveoli to the blood and then to the tissues.
CO2 tension is higher in the blood so passes from the blood to the alveoli.

Oxygen is transported in the blood in 2 ways

1. **Dissolved in the plasma = 0.3 volume %. Small but important in determining the oxygen tension gradient from the plasma to the tissues.**
2. **Combined with haemoglobin in the red cell.**

Almost all the oxygen in the blood is bound to hemoglobin, so interfering with this carrier molecule limits oxygen delivery to the periphery.

Hemoglobin increases the oxygen-carrying capacity of blood by about 40-fold,

with the ability of hemoglobin to carry oxygen influenced by the partial pressure of oxygen in the environment, a relationship described in the oxygen–haemoglobin dissociation curve. When the ability of hemoglobin to carry oxygen is interfered with, a hypoxic state can result.

At tensions above 100mm Hg the haemoglobin is fully saturated with oxygen and the dissociation curve is plotted as a percentage saturation against tension.

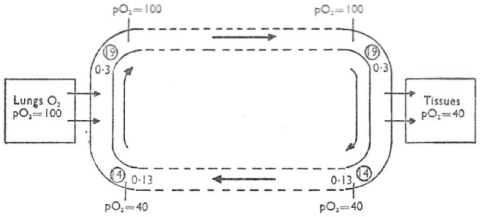
The Bohr Effect
In addition to tension and haemoglobin content, the oxygen content of the blood depends upon the CO_2 being carried simultaneously. An increase in pCO_2 from the normal value of 40mm Hg shifts the oxygen dissociation curve thus less oxygen is carried at a given tension.

Markers for Hypoxia

Strong muscle weakens to

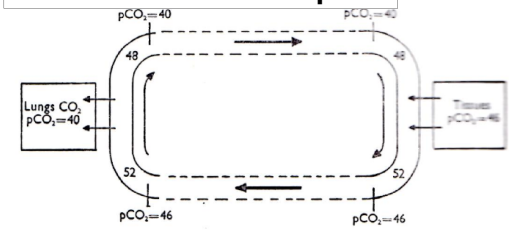
CO2
and / or
Xanthine oxidase

Oxygen transport



Blood leaves the lungs at an oxygen tension of 100mm Hg and returns at 40mm Hg.

Carbon dioxide transport



Only 4ml% is gives off in the passage through the lungs which equals the amount taken up by the tissues.

Oxygen into the Blood

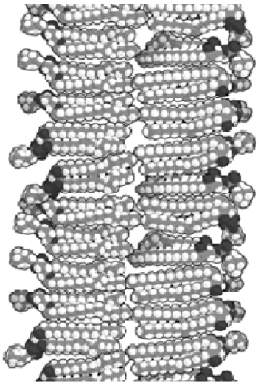
The alveoli are located in the respiratory zone of the lungs, at the distal termination of the alveolar ducts and atria. These air sacs are the forming and termination point of the respiratory tract. They provide total surface area of about 100 $m^{2.}$

The alveoli consist of an epithelial layer and extracellular matrix surrounded by capillaries. The alveoli contain some collagen and elastin fibres. The elastic fibres allow the alveoli to stretch as they are filled with air during inhalation. They then spring back during exhalation in order to expel the carbon dioxide-rich air.

Plasma membranes consist of both lipids and proteins. The fundamental structure of the membrane is the phospholipid bilayer, which forms a stable barrier between two aqueous compartments. In the case of the plasma membrane, these compartments are the inside and the outside of the cell.

Plasma membranes of human cells contain four major phospholipids
1. Phosphatidylcholine,
2. Phosphatidylethanolamine
3. Phosphatidylserine,
4. Sphingomyelin
which together account for more than half of the lipid in most membranes.

These phospholipids in human red blood cells are asymmetrically distributed between the two halves of the membrane bilayer.



The outer leaflet consists mainly of phosphatidylcholine, sphingomyelin and glycolipids

Where as phosphatidylethanolamine and phosphatidylserine are the predominant phospholipids of the inner leaflet.

A fifth phospholipid, phosphatidylinositol, is also localized to the inner half of the plasma membrane.

Although phosphatidylinositol is a quantitatively minor membrane component, it plays an important role in cell signalling.

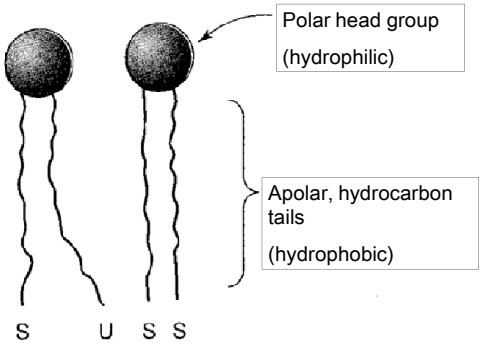
The head groups of both phosphatidylserine and phosphatidylinositol are negatively charged, so their predominance in the inner leaflet results in a net negative charge on the cytosolic face of the plasma membrane.

In addition to the phospholipids, the plasma membranes of animal cells.contain glycolipids and cholesterol. The glycolipids are found exclusively in the outer leaflet of the plasma membrane, with their carbohydrate portions exposed on the cell surface.

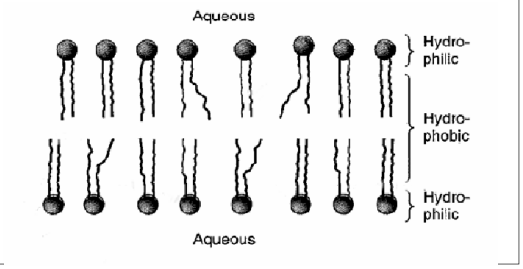
They are relatively minor membrane components, constituting only about 2% of the lipids of most plasma membranes.
Cholesterol is a major membrane constituent of human cells, being present in about the same molar amounts as the phospholipids.

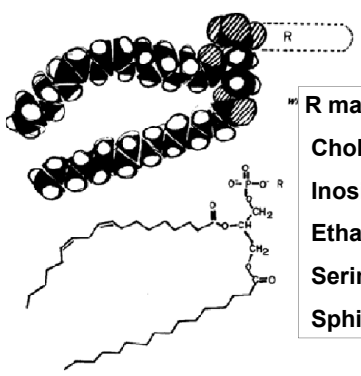
Phospholipids

A Phospholipid



The unsaturated fatty acid tails are kinked and lead to more spacing between the polar heads and hence more movement.





R maybe

Choline

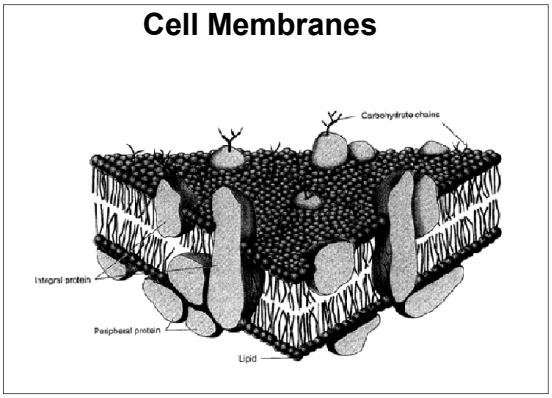
Inositol

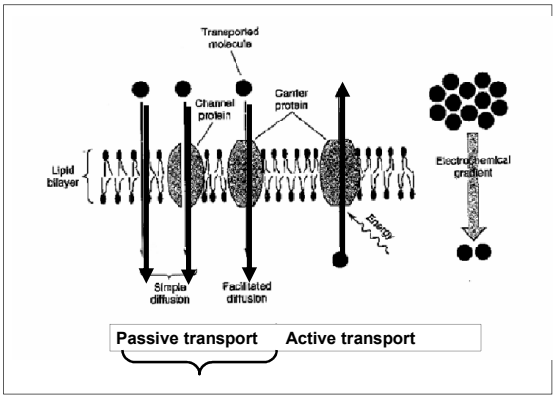
Ethanolamine

Serine

Sphingomyelin

Cell Membranes





Key nutrients for synthesising the phospholipids

Acetyl CoA (Vit B5, Magnesium, P5P)
NAD, NADPH (Vit B3 complex)
Mg, Zn, SAM (Mg, P-5-P, Folates, B12)
Choline
Serine
Inositol
Saturated fatty acids C16-18
Unsaturated fatty acids C18-24
Lecithin

Hemoglobin saturation
The quantity of oxygen carried by the saturated blood will depend upon the haemoglobin content of the red cells. With a normal haemoglobin of 14.5gm/100ml blood 20ml of oxygen will combine with the haemoglobin in every 100ml of blood (20 volume %).

The amount carried when fully saturated is called the oxygen capacity.

Hemoglobin is also found outside red blood cells in the A9 dopaminergic neurons in the substantianigra, macrophages, alveolar cells, and mesangial cells in the kidney. In these tissues, hemoglobin has a non-oxygen-carrying function as an antioxidant and a regulator of iron metabolism.

Anemias

Anaemia is a decrease in number of red blood cells or less than the normal quantity of hemoglobin in the blood. Anaemia may also be diagnosed where there is decreased oxygen-binding ability of each hemoglobin molecule due to deformity or lack in numerical development as in some other types of hemoglobin deficiency.

1. Red cell aplasia
2. Aplastic anaemia
3. Microcytic anaemia – Iron deficiency
4. Macrocytic anaemia's –
Vitamin B12
Folic acid
5. Hemolytic anaemia
6. Blood loss
7. Fluid overload

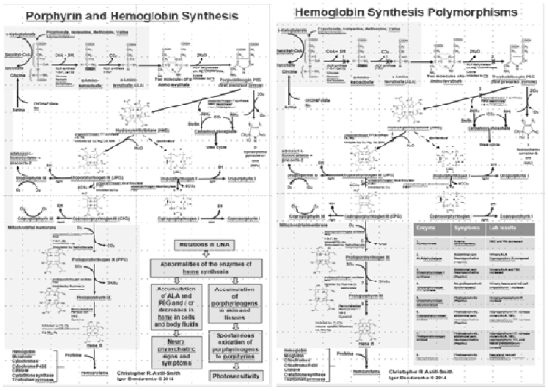
Iron deficiency maybe due to
1. **Diet**
2. **Malabsorption**
3. **Parasites**
4. **Haemorrhage**

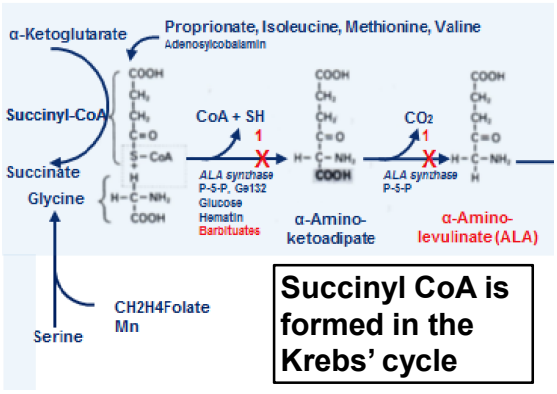
Supplement with
Ferrous phosphate RED body types
Ferrous Chloride GREEN body types
Ferrous sulphate BLUE body types
Iron citrate

Hemoglobin and Myoglobin contain heme, a cyclic tetrapyrrole consisting of 4 molecules of pyrrole. One atom of ferrous iron resides at the centre.

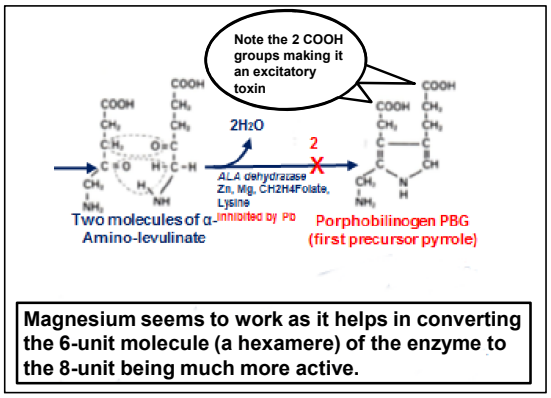
Heme-dependent enzymes

Catalase
Myeloperoxidase
Eosinophil peroxidase
Various peroxidases
i-Nitric Oxide Synthase (iNOS)
Cystathione synthase
Cytochrome p450
Cytochromes for energy production
Sulfite oxidase
Thyro-peroxidase
COX 1 and COX 2 **Tryptophane pyrrolase**

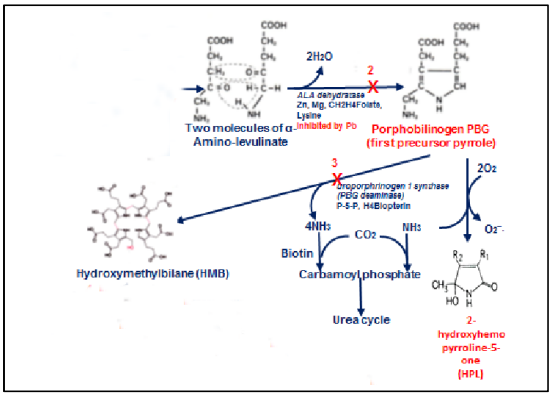


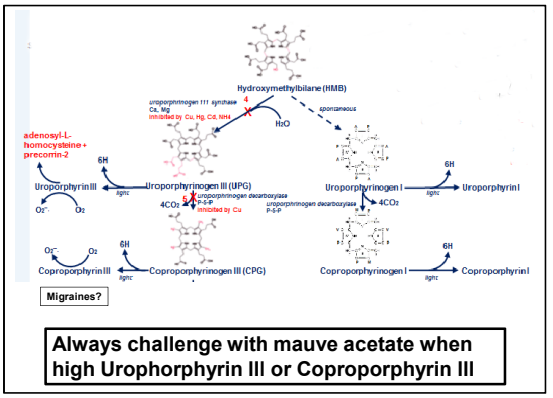


Succinyl CoA is formed in the Krebs' cycle



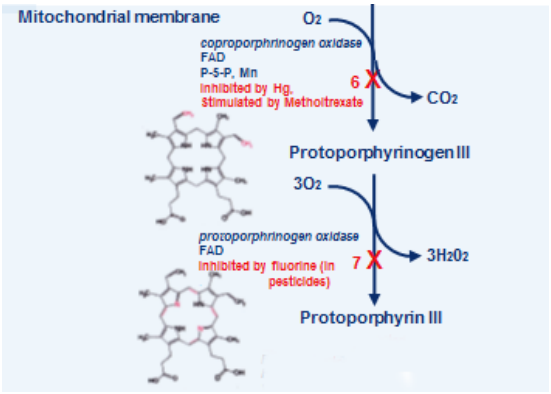
Magnesium seems to work as it helps in converting the 6-unit molecule (a hexamere) of the enzyme to the 8-unit being much more active.

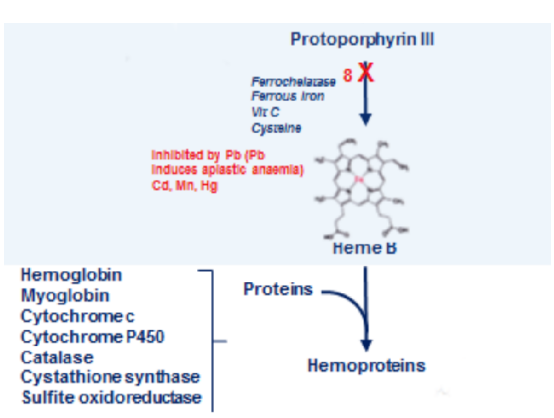




Always challenge with mauve acetate when high Urophorphyrin III or Coproporphyrin III

400nm

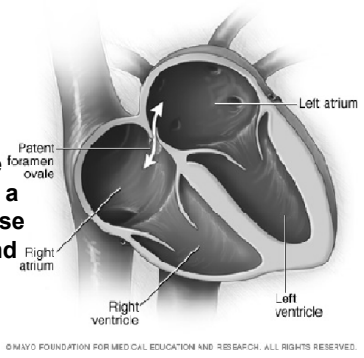




Heme is made in every cell in the body but primarily in the liver, bone marrow and red blood cells. 40% of heme goes to synthesising CYP 450 enzymes.

Steven Rochlitz hypothesised that the chronic MCS patient has one or more defects that that leads to him / her having Blood Brain Barrier Permeability (BBBP).
The common hidden heart defect, Patent Foramen Ovale and other medical conditions cause BBBP and gut permeability problems.

Patent Foramen Ovale is probably present in one in three people. It is a leading cause of stroke and migraines with visual auras.



Alzheimer's disease is being linked to porphyria also. In 2004 some 4.5 million Americans were said to have the disease.
By age 85 one out of two Americans has Alzheimer's!

Hemoglobin is composed of heme with one Fe2+ and a globin protein composed of an alpha chain of 141 amino acids and one beta chain of 145 amino acids.

Alpha chain	Beta chain
Phenylalanine 6	Phenylalanine 8
Lysine 11	Lysine 9
Threonine 9	Threonine 6
Valine 11	Valine 18
Methionine 2	Methionine 1
Leucine 17	Leucine 18

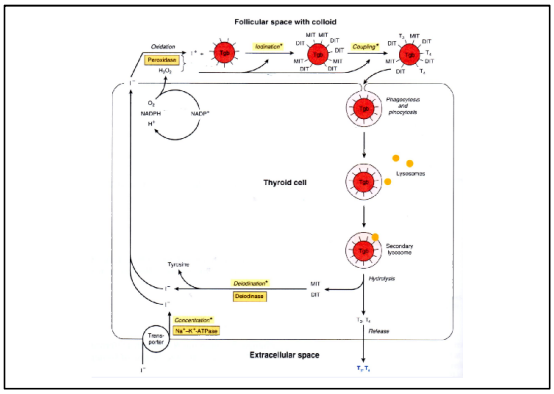
Myoglobin in muscle cells stores oxygen in the resting state as oxymyoglobin and on exercise releases oxygen.
It is composed of the same amino acids as in haemoglobin.

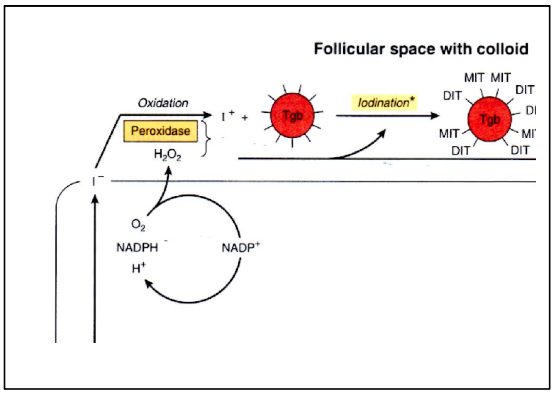
Newly identified Neuroglobin accounts for nerve cells taking up oxygen.

Oxygen (O2) nitric oxide (NO), carbon monoxide (CO) and hydrogen sulfide (H2S) bind to the iron atom in heme proteins. Once bound to the prosthetic heme groups, these molecules can modulate the activity/function of those hemeproteins, affording signal transduction.

Myeloperoxidase (MPO) is a peroxidase enzyme and is most abundantly expressed in neutrophil granulocytes. MPO has a heme pigment, which causes its green colour in secretions rich in neutrophils, such as pus and some forms of mucus.

Thyroid peroxidase is an enzyme expressed mainly in the thyroid that liberates iodine for addition onto tyrosine residues on thyroglobulin for the production of thyroxine (T_4)or triiodothyronine (T_3), the thyroid hormones.

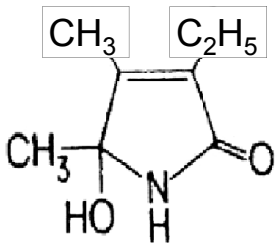




Pyroluria is known by many different names including Pyrrole Disorder, Kryptopyrrole, Kryptopyrroluria, Pyrroluria, Pyrolle Disorder, Mauve Factor and Hemepyrrole. Pyroluria can best be described as the abnormal synthesis and metabolism of the oxygen carrying molecule haemoglobin.

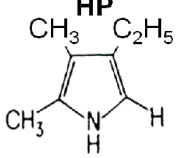
As with all cells there are waste or by-products produced and the by-product of haemoglobin is a metabolite called hydroxyhemopyrrolin-2-one (HPL) also known as Pyrrole. The metabolite was originally thought to be a Kryptopyrrole but further studies have proven this not to be the case.

The Mauve Factor

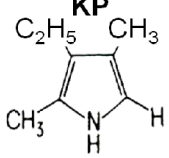


HPL (hydroxyhemopyrrolin-2-one)

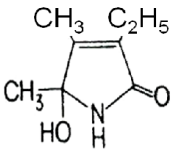
hemopyrrolle
HP



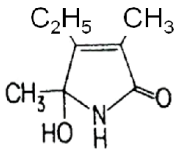
kryptopyrrole
KP



hydroxyhemopyrrolin-2-one
OHHPL



hydroxykryptopyrrole lactame
OHKPL



Mauve history

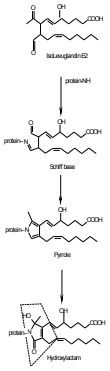
- **Discovered in urine in 1957**
- **Named for lilac-coloured appearance on paper chromatograms developed with Erhlich's reagent**
- **Labile and elusive**
- **Abram Hoffer is the father of Mauve**

Abram Hoffer (November 11, 1917 – May 27, 2009) was a Canadian biochemist, physician and psychiatrist known for his "adrenochrome hypothesis" of schizo affective disorders. According to Hoffer, megavitamin therapy and other nutritional interventions are potentially effective treatments for schizophrenia and other diseases. Hoffer was also involved in studies of LSD as an experimental therapy for alcoholism and the discovery that high dose niacin can be used to treat high cholesterol and other dyslipidemias.

Mauve Factor is strongly associated with depletion of arachidonic acid (Bibus), which is attacked by free radicals to form levuglandins and isolevuglandins, which in turn produce pyrrolic tissue adducts. These pyrrolic adducts consistently auto-oxidize to form a hydroxy-lactam (Salomon), and the pyrrolic moiety of these adducts corresponds precisely to the structure of HPL. Urinary pyrroles are known to result from the formation of pyrrolic tissue adducts (Batoreu).

Boxed-area is HPL, putative Mauve Factor

(Hydroxyhemo pyrrolin-2-one)



Pfeiffer correlates

- Nail spots
- Stretch marks
- Pale skin
- Poor tanning
- Knees and joints
- Constipation
- Dream recall
- Morning nausea
- Light and sound
- Odour intolerance
- Migraines
- Stitch-in-side

Walsh

- Low stress tolerance
- Anxious, overly pessimistic
- Explosive anger
- Hyperactivity

Kruesi

- Social withdrawal
- Emotionally labile
- Loss of appetite
- Easily fatigued

- Abnormal fat distribution
- Irritable bowel
- Delayed puberty
- Irregular periods
- Overcrowded teeth
- Joint pains
- Reading difficulties
- Motion sickness
- Auditory processing disorder
- Memory loss
- Insomnia

- Sugar craving
- Poor morning appetite
- Frequent infections
- Allergies
- Impotence
- Sweet breath and body odour
- Paranoia
- Seizure
- Intolerance to bright light

Pyroluria and Gluten Sensitivity
It is not uncommon for those with this condition to have gluten and casein sensitivity. This condition is more prevalent in many of the same populations that we see increased prevalence of gluten sensitivity. It can cause wide ranging symptoms.

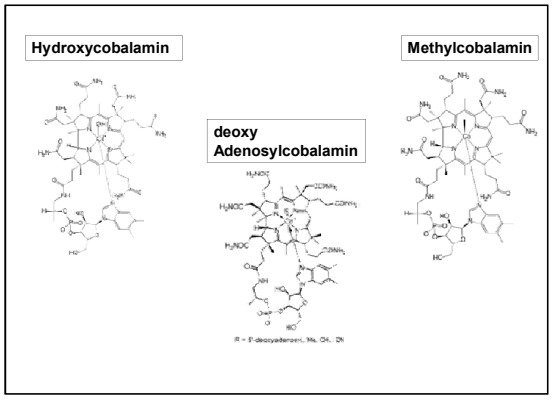
Vitamin B12
1. Hydroxycobalamin
2. Adenosylcobalamin
3. Methylcobalamin
Vitamin B_{12} is a water soluble vitamin with a key role in the normal functioning of the brain and nervous system, and for the formation and maturation of red blood cells.

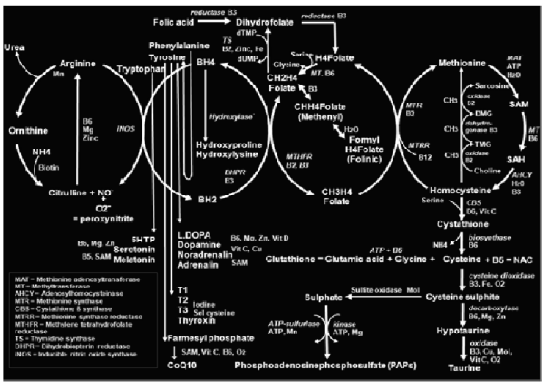
It is normally involved in the metabolism of every cell of the human body, especially affecting DNA synthesis and regulation, but also fatty acid synthesis (especially odd chain fatty acids) and energy production.

Only bacteria have the enzymes required for its synthesis, although many foods are a natural source of B_{12} because of bacterial symbiosis and usually produce hydroxocobalamin), but conversion between different forms of the vitamin can be accomplished in the human body.

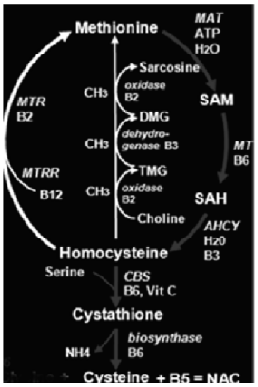
Vitamin B_{12} was discovered from its relationship to the disease pernicious anemia, which is an autoimmune disease in which parietal cells of the stomach responsible for secreting intrinsic factor are destroyed, the same cells responsible for secreting acid in the stomach.

Intrinsic factor is crucial for the normal absorption of B_{12}, so a lack of intrinsic factor, as seen in pernicious anemia, causes a vitamin B_{12} deficiency. Many other subtler kinds of vitamin B_{12} deficiency and their biochemical effects have since been elucidated.





Methionine synthase, **is a methyltransferase enzyme, which uses the MeB_{12} to catalyze the conversion of the homocysteine back into methionine. This functionality is lost in vitamin B_{12} deficiency, and can be measured clinically as an increased Homocysteine level.**



Myelin damage resulting from B_{12} deficiency, even in the presence of adequate folate and methionine, is more specifically and clearly a vitamin deficiency problem. It has been connected to B_{12} most directly by reactions related to *MUT*, which is required to convert methylmalonyl coenzyme A into succinyl CoA.

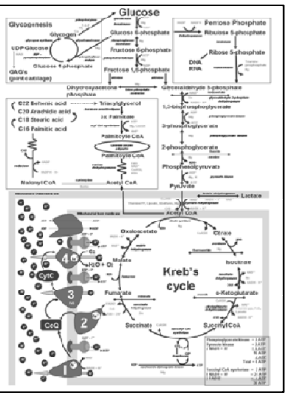
Failure of this second reaction to occur results in elevated levels of MMA, a myelin destabilizer. Excessive MMA will prevent normal fatty acid synthesis, or it will be incorporated into fatty acid itself rather than normal malonic acid.

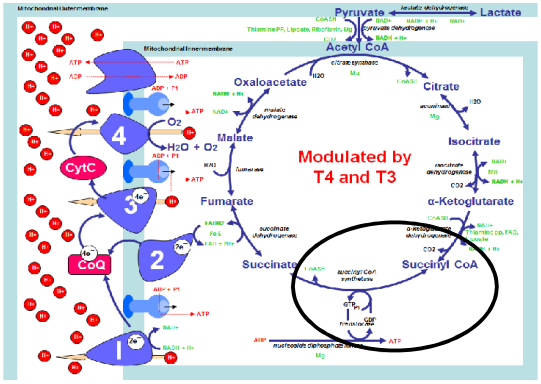
If this abnormal fatty acid subsequently is incorporated into myelin, the resulting myelin will be too fragile, and demyelination will occur.

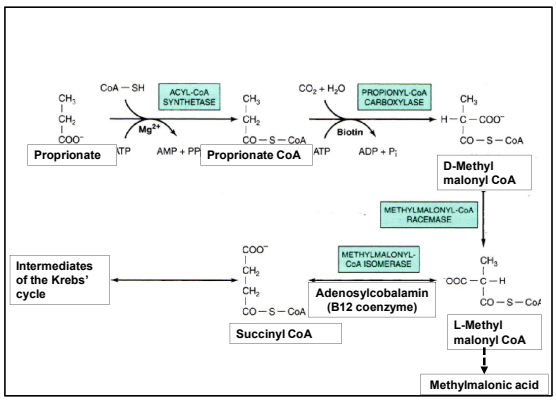
Methylmalonyl CoA is formed as an intermediate in the catabolism of valine and by the carboxylation of proprionyl CoA arising in the catabolism of isoleucine, cholesterol and odd numbered fatty acids or directly from proprionate a major product of microbial fermentation in the rumen.

Energy production

1. Glycolysis
2. Krebs' Cycle
3. Electron transport





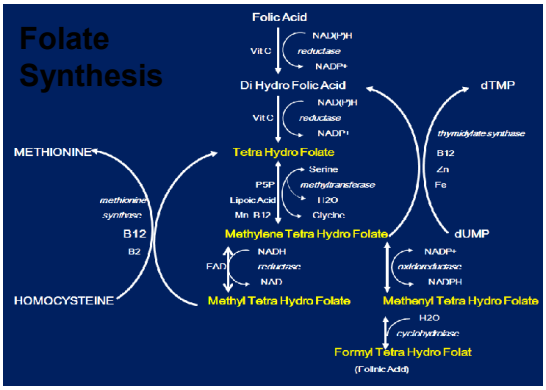


Folate deficiency limits cell division, erythropoiesis, production of red blood cells, is hindered and leads to megaloblastic anemia, which is characterized by large immature red blood cells.

This pathology results from persistently thwarted attempts at normal DNA replication, DNA repair, and cell division, and produces abnormally large red cells called megaloblasts with abundant cytoplasm capable of RNA and protein synthesis, but with clumping and fragmentation of nuclear chromatin.

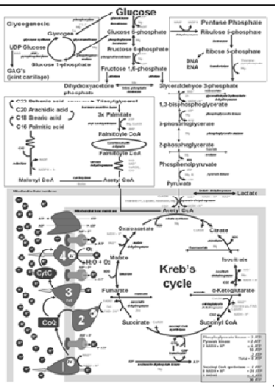
Folic acid is itself not biologically active, but its biological importance is due to tetrahydrofolate and other derivatives after its conversion to dihydrofolic acid in the liver.

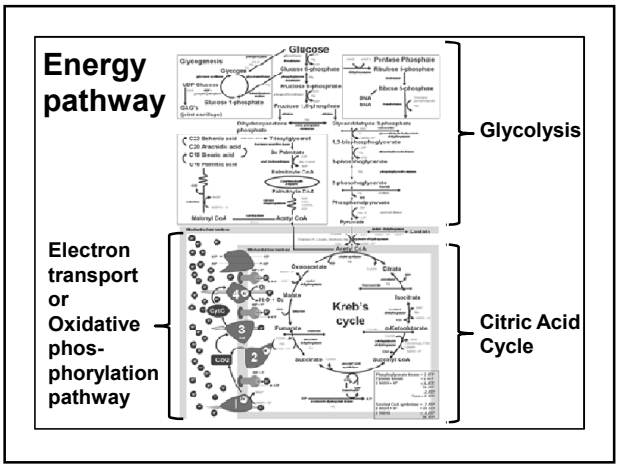
H4Folate Tetrahydrofolate
CHH4Folate Methenyl tetrahydro folate
CH2H4Folate Methylene tetrahydro folate
CH3H4Folate Methyl tetrahydro folate

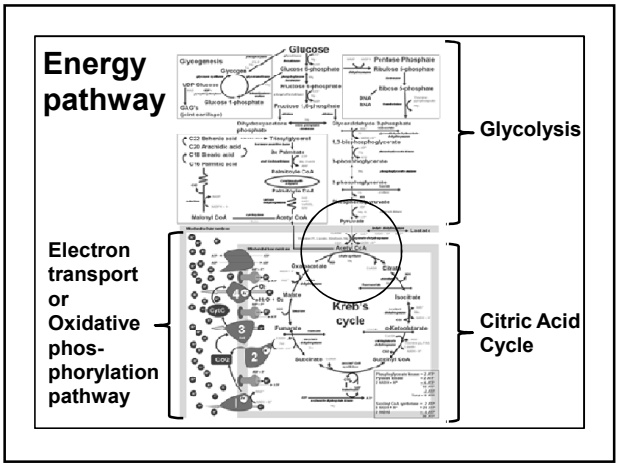


Oxygen into the Mitochondria and where it Functions

Energy pathway




Energy pathway
Glycolysis
Electron transport or Oxidative phos-phorylation pathway
Citric Acid Cycle
Kreb's cycle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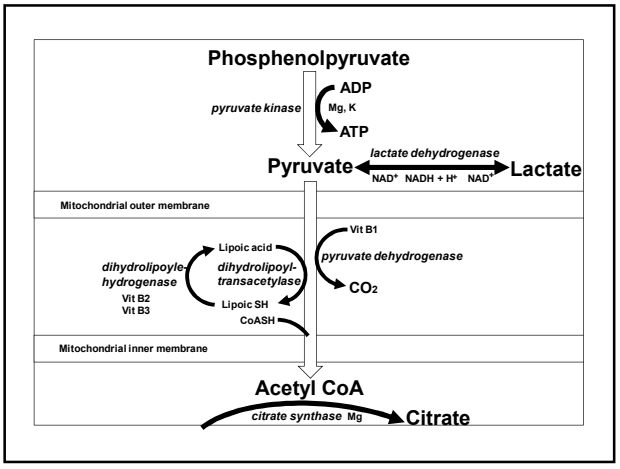
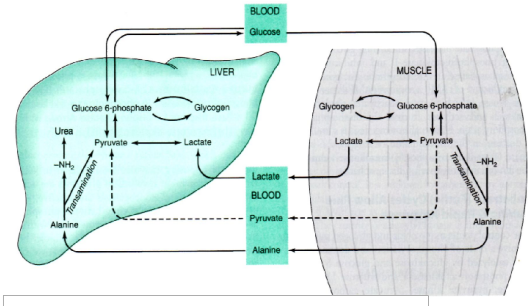

Phosphenolpyruvate
pyruvate kinase
ADP
Mg, K
ATP
Pyruvate
lactate dehydrogenase
NAD+ NADH + H+ NAD+
Lactate
Mitochondrial outer membrane
Vit B1
pyruvate dehydrogenase
CO2
dihydrolipoyle hydrogenase
Vit B2
Vit B3
Lipoic acid
dihydrolipoyl-transacetylase
Lipoic SH
CoASH
Mitochondrial inner membrane
Acetyl CoA
citrate synthase Mg
Citrate

Lactic acid
Tissues that function under hypoxic conditions produce lactic acid.

D/L Lactic acid – RED body types
L. Lactic acid – GREEN body types
D. Lactic acid- BLUE body types



The Lactic Acid (Cori Cycle)

Under anaerobic conditions NADH cannot be reoxidized through the respiratory chain to oxygen. Pyruvate is reduced by NADH to lactate catalysed by *lactate dehydrogenase*. There are three different specific isoenzymes of *lactate dehydrogenase* that have clinical significance.

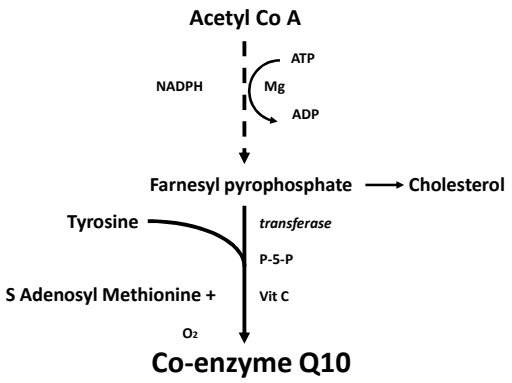
The re-oxidation of NADH via lactate formation allows glycolysis to proceed in the absence of oxygen by regenerating sufficient NAD for another cycle of the reaction catalysed by *glyceraldehyde-3-phosphate dehydrogenase*.

Some tissues derive much of their energy from glycolysis and produce lactate –

Erythrocytes	**Brain**
GI tract	**Renal medulla**
Retina	**Skin**

The liver, kidney and heart usually take up lactate and oxidize it but will produce it under hypoxic conditions

Coenzyme Q10



Coenzyme Q10 (ubiquinone) is a lipid-soluble compound that occurs in all kinds of cell membranes in the human body. It has several biochemical functions:

- **it is indispensable for producing energy in the cells in the form of ATP**
- **it is an essential fat soluble antioxidant**
- **it helps regenerate other antioxidants esp Vit E**
- **it stimulates cell growth and inhibits cell death**

- **It is beneficial for the prevention of cell damage in hypoxia, especially in the cardiac muscle. It has been used for the protection of myocardium in different cardiovascular disorders, such as angina pectoris, hypertension, arrhythmia and congestive heart failure.**

- **It has been proven to have anti-tumour and immune system enhancing properties when tested in animals.**
- **Genetic mutations, ageing, cancer and statin-type drugs can cause a decrease in the levels of coenzyme Q10 in tissues and blood.**

- **Low ratio of coenzyme Q10 to low-density lipoprotein (LDL) cholesterol is a strong indicator of risk of atherosclerosis (clogging of the arteries)**

Best sources mg / Kg
Beef, pork and chicken heart 113+
Beef, pork and chicken liver 50+
Sardines and red flesh fish 50+
Soy, olive, grape seed oils 50+
Peanuts, sesame, pistachio, hazelnuts 20+
Parsley 20+
Avocado 10+

Muscle Oxygen Requirements during Exercise

A muscle requires approximately 50x more oxygen per minute when active than when at rest. This is achieved by
1. An increase in lung blood flow and cardiac output from 5 litres per minute to 50 litres per minute.

2. Redistribution of the blood flow to the active muscles.

3. More oxygen is extracted from every 100ml of blood passing through the muscle as a result of lowered oxygen tension in the muscles.

Optimal products
Dosing
Timing

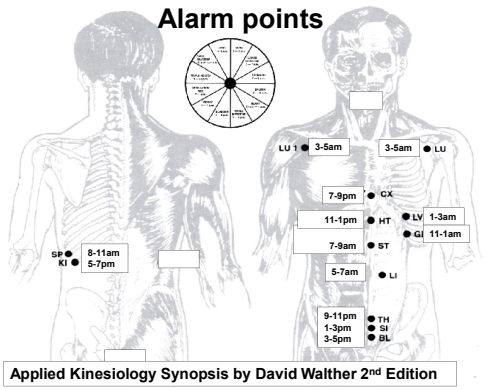
Optimal products
Must remain strong to rechallenging with body type coloured acetate

Dosing
Amount of liquid or capsules that strengthen weak muscle(s)

Timing
Cross therapy localise to the alarm points for remaining strong. Those that remain strong are the optimal times of dosing.

Usually St, SI, Cx or TW

Alarm points



Applied Kinesiology Synopsis by David Walther 2nd Edition

Timing
1. Amino acids 15 minutes before breakfast
2. Vitamins and Minerals with meals
3. Fatty acids with evening meal
4. Probiotics, CoQ10, Folic acid last thing at night.
5. Herbs and spices between or before meals.

Mitochondria

From "The Concept of Cell Symbiosis" by Dr Heinrich Kremer
"The way out of the therapeutic dead end"

There are on average 1500 mitochondria in every body cell with the exception of the red blood cells. In heart muscle cells they average 2000 and in nerve cells up to 5000. In the heart, mitochondria account for 70% of its weight. When mitochondria cannot work normally, the production of energy is by mitochondria is disrupted.

The energy ATP is no longer produced with the assistance of oxygen but outside the mitochonfria in the cytoplasm and without oxygen by glycolysis or in less serious disruptions with oxygen but without the production of oxygen radicals.

In the process the differentiated cell performances of all organelle systems are no longer maintained but instead the cell division cycle is activated.
The word "Mitochondria" comes from the Greek *mitos* meaning thread and *chondros* meaning grain.

90% of the oxygen we inhale is required in mitochondria for the modulation of energy. This form of energy production within the mitochondria is termed "high performance energy". This energy is not only heat energy but more importantly information energy with driving functions.

In the "high performance model" reactive oxygen radicals are always and unavoidably formed which can damage potential cells and mitochondria. If they are not neutralized, cell or mitochondria membrane components or genetic fragments could be damaged or destroyed. An up to 80% loss of mitochondria occurs in cancer cells.

Free radicals like oxygen and NO gas play an important role in the defence against tumour cells and pathogen, proliferating within cells and is a completely normal physiological process.
Sulfur compounds are decisive for neutralizing these radicals such as reduced glutathione and sulfur containing foods.

If in the production of mitochondrial energy the accumulating oxygen radicals or industrial toxins can non longer be quenched, they can potentially cause serious damage at a cellular level. In order to protect themselves from this the mitochondria reduce their activities.

In doing so there are fewer oxygen radicals produced but the consequence is a drop in system cell performance. Dr Kremer called this process the "protective switch". Here the energy production is switched from the mitochondria to the cytoplasm.

From an evolutionary biological viewpoint the older cell division program governed by the anaerobic archaeal portion of the partnership is activated utilizing blood sugar which activates cell division.

Three domains of kingdom of Life

1. **Archaea – single celled organisms lacking nuclei.**
2. **Bacteria – also lacking nuclei**
3. **Eukarya – contain nuclei (single cell protists, multi cellular algae, fungi, plants, animals and humans).**

All Eukarya, including humans owe their existence to a unique act of fusion in evolution, namely the colonization of a voluminous type of Archaea as a host / stem cell by single cellular organisms from the bacteria domain. This intracellular symbiosis from members of different domains took place 2.1 billion years ago.

This was the time when the earth's atmosphere was changing from methane to oxygen. Before the Ice age of 4.5 billion years ago the atmosphere was dominated by methane and carbon dioxide. CH_4 was produced by the anaerobic Archaea which convert CO_2 to CH_4 and CO_2 was due to volcanic activities.

After the melting of the ice the O_2 concentration rose while methane concentrations fell exponentially. Cell symbiosis took place at exactly the point in time these two atmospheric gas curves intersected allowing certain Archaea to become facultative aerobes to produce ATP.

ATP metabolism has been demonstrated by microbiologists in methane producing Archaea and bacteria. In oxygen free milieus these archaea can survive by switching ATP production to glycolysis.

This action of facultative aerobic archaea was the decisive condition for cell symbiosis with the bacteria symbionts which had already developed an O2 dependant respiratory chain.
Roughly 60% of the genes in the human genome are derived from the genes of stem cells of facultative aerobic archaea termed A- Genome.

The A-genome is dominant during the cell division cycle from the DNA replication phase. The other 35% termed B-genome came predominantly from the genes ascribed to bacterial symbiosis in the mutual nucleus. The B-genome is dominant during the phases of differentiated cell activities.

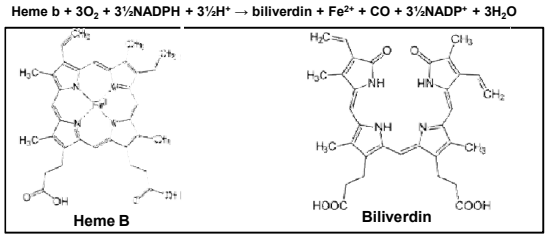
Otto Warburg in the 1920's described the phenomenon that cancer cells, despite the presence of O2 seemed to undertake ATP production mainly via glycolysis in the cytoplasm.

If the electron flow in Complex 4 of the respiratory chain to O2 is permanently disturbed then a failure in the modulation of ATP occurs and increasing numbers of oxygen and other radicals form that can attack and damage the macromolecules (nucleic acids, proteins, lipids).

In order to prevent this danger the key enzyme hemeoxygenase up-regulates. The enzyme uses O2 as co-factor for the production of carbon monoxide (CO). In cases of long-term surplus production CO gas has crucial effects on cancer cell transformation.

Heme oxygenase is an enzyme that catalyzes the degradation of heme. This produces biliverdin, iron, and carbon monoxide. It cleaves the heme ring at the alpha-methene bridge to form either biliverdin or, if the heme is still attached to a globin, verdoglobin.

Biliverdin is subsequently converted to bilirubin by biliverdin reductase.



This reaction can occur in virtually every cell; the classic example is the formation of a bruise, which goes through different colours as it gradually heals: red heme to green biliverdin to yellow bilirubin. Under normal conditions, the activity of heme oxygenase is highest in the spleen, where old erythrocytes are sequestrated and destroyed.

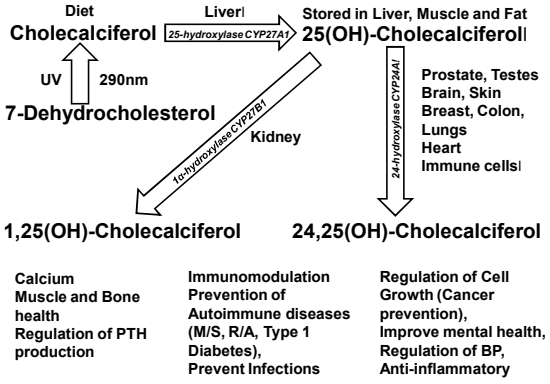
1. CO gas effects a characteristic phase shifting of the absorption of visible light from components of the respiratory chain and as a result short ciruits the photon switch for the modulation of the information transfer to the mitochondrial ATP.

2. CO activates in the cytoplasm certain regulatory proteins for the stimulation of cell division cycle without external growth signals.
3. CO effects overstimulation of cGMP
4. CO gas blocks programmed cell death by bonding onto the bivalent iron in important key enzymes.

When O2 is deficient the even more effective cyanide gas (CN^-) is formed instead of CO. CN^- is in humans the strongest mitochondrial respiratory poison and produces a stronger phase switching of the absorption of visible light.

Vitamin D

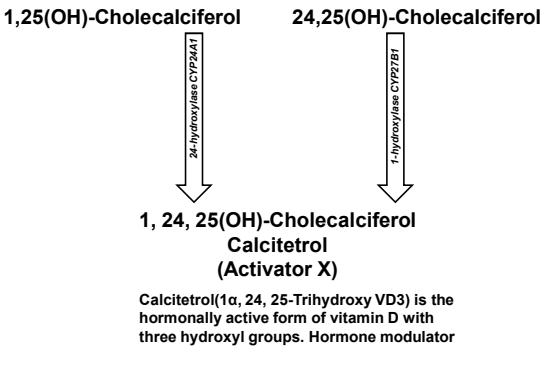
Calciferol



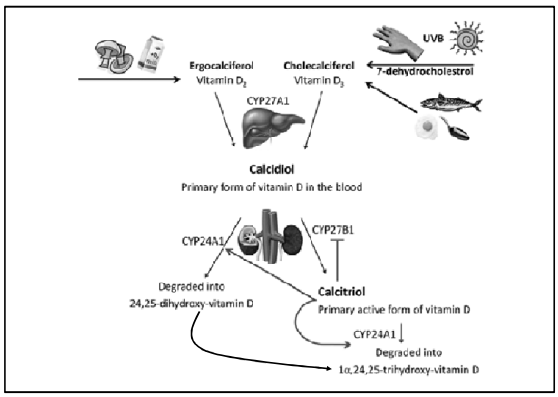
Calcium
Muscle and Bone health
Regulation of PTH production

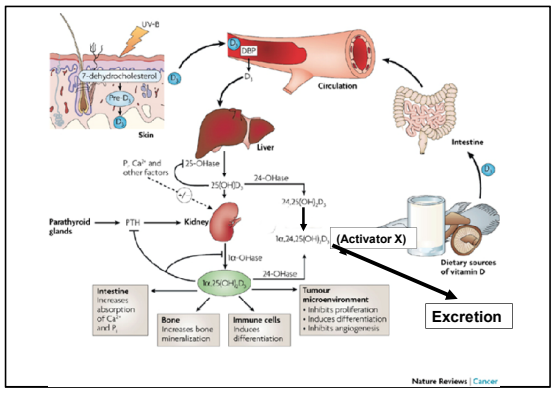
Immunomodulation
Prevention of Autoimmune diseases (M/S, R/A, Type 1 Diabetes),
Prevent Infections

Regulation of Cell Growth (Cancer prevention),
Improve mental health,
Regulation of BP,
Anti-inflammatory



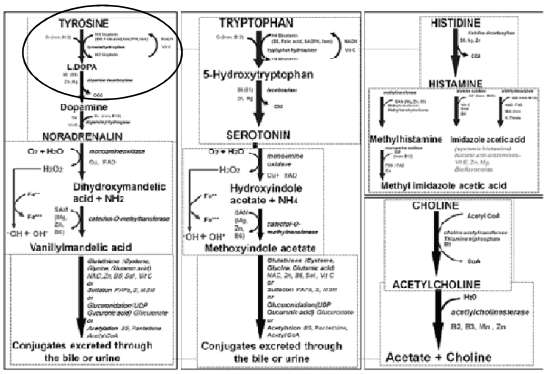
Calcitetrol(1α, 24, 25-Trihydroxy VD3) is the hormonally active form of vitamin D with three hydroxyl groups. Hormone modulator

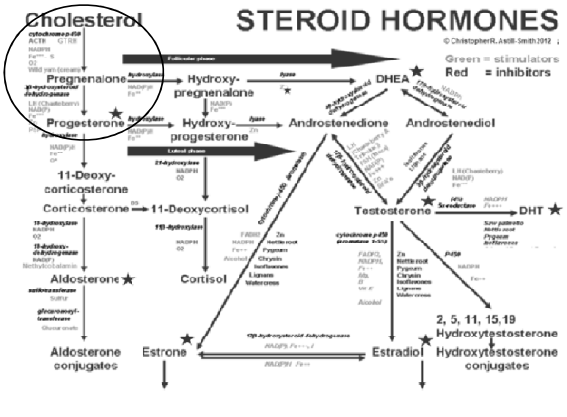




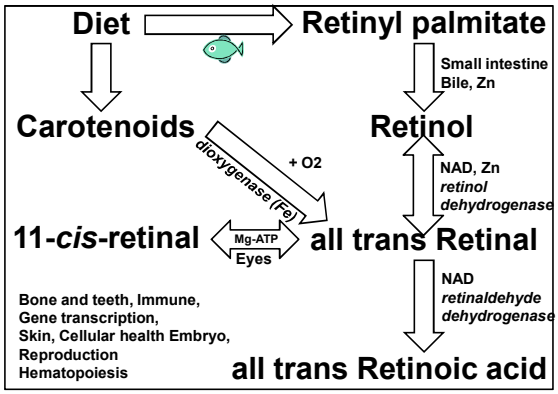
Enzymes that are induced by Vitamin D

Enzymes that are induced by Vitamin D
Tyrosine hydroxylase
Tryptophan hydroxylase
Cholesterol to pregnenalone
Pregnenalone to Progesterone
Nitric oxide synthase
Increases Glutathione levels





Vitamin A



Selenium (phosphate)

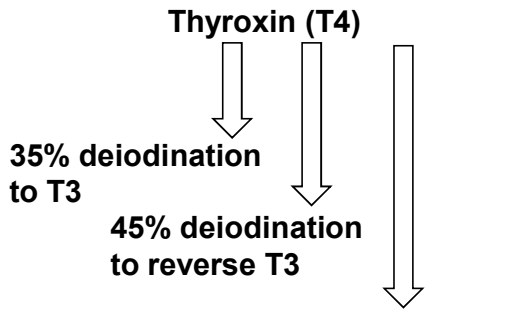
Selenium (phosphate)
Biosynthesis of selenoproteins requires Cysteine or Methionine + Selenate ($SeO4^{--}$) + ATP + $H2O$ + a Selenium dependant enzyme *(selenophosphate synthetase).*

Selenium (phosphate)
Sodium selenate 100mcg
Adenosine triphosphate 100mg

Open capsules up and dissolve in water before swallowing.

Selenium dependant enzymes
Selenoproteins
At least 25 selenoproteins have been identified, but the metabolic functions have been identified for only about one-half of them
Main ones are
1. Thyroid deiodinase (T4 > T3)
2. Glutathione peroxidase

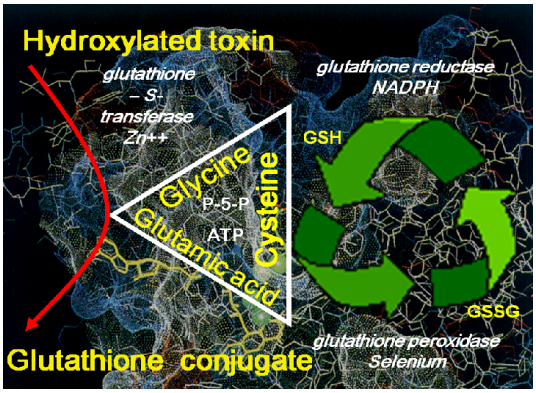
1. Thyroid deiodinase (T4 > T3)
Three different selenium-dependent iodothyronine deiodinases (types I, II, and III) can both activate and inactivate thyroid hormone by acting on T_3, T_4, or other thyroid hormone metabolites essential for normal development, growth, and metabolism.



2. Glutathione peroxidase
Five selenium-containing glutathione peroxidases (GPx) have been identified:
1. **Cellular or Classical GPx**
2. **Plasma or Extracellular GPx**
3. **Phospholipid hydroperoxide GPx**
4. **Gastrointestinal GPx**
5. **Olfactory GPx**

Although each GPx is a distinct selenoprotein, they are all antioxidant enzymes that reduce potentially damaging ROS, such as hydrogen peroxide and lipid hydroperoxides, to harmless products like water and alcohols by coupling their reduction with the oxidation of glutathione.

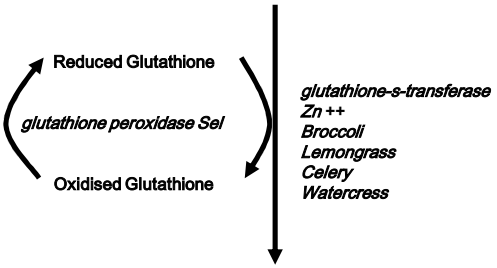
Sperm mitochondrial capsule selenoprotein, an antioxidant enzyme that protects developing sperm from oxidative damage and later forms a structural protein required by mature sperm, was once thought to be a distinct selenoprotein but now appears to be phospholipid hydroperoxide GPx..



Glutathione conjugation (cysteine, glycine and glutamic acid) is catalyzed by *glutathione-S-transferase.*

This enzyme is present mostly in the cell cytosol.

Phase 1 toxic intermediate



Glutathione (P-5-P) conjugate

A failure in the glutathione conjugation would lead to covalent combination to DNA and RNA and other cell proteins creating serious cell damage. They are further metabolised before excretion. The glutamic and glycine groups are removed and an acetyl group donated by Acetyl CoA is added to the cysteine moiety.

Fat soluble toxins are primarily metabolized by phase 1, phase 2 liver detoxification. The most powerful component of this system is glutathione. Fat soluble toxins can completely eradicate total glutathione levels. When glutathione is depleted all of the thiols become depleted to include S-adenosyl-methionine (SAMe), L-cysteine, L-methionine, cystathione, etc. Toxin exposure through glutathione depletion collapses methylation as SAMe (the body's one carbon methyl donor) is depleted.

L-cysteine is the rate limiting step in the synthesis in glutathione. It is freely converted into glutathione. Be it during weight loss or other fat soluble toxin exposure in the course of normal day-to-day activities the glutathione may become completely depleted. Search PubMed, There are hundreds of articles which link methylation collapse to almost every cancer known. The toxin takes out the glutathione then overwhelms the body at which point methylation collapses This methylation collapse is not from a 5-MTHF reductase polymorphism, but from total depletion of the sulfur containing amino acid (thiol) substrate. When total thiol collapse occurs secondary to toxin exposure no amount of polymorphism attention will bring the system back to normal function. Thiol amino acid precursors are needed.

The resulting compound is a mercapturic acid, a conjugate of N. Acetyl Cysteine, which is then excreted in the urine.

N. Acetyl Cysteine is thus an excellent supplement to use to up-regulate this pathway.

N.Acetyl Cysteine aids detoxification

1. **Glutathione**
2. **Acetylation**
3. **Sulfation**
4. **Cysteine**

Other Selenium dependant enzymes

3. *Thioredoxin reductase* participates in the regeneration of several antioxidants, possibly including vitamin C and Vitamin E.

4. Selenoprotein P is found in plasma and also associated with vascular endothelial cells (cells that line the inner walls of blood vessels).

It functions as an antioxidant that protects endothelial cells from damage induced by peroxynitrite.

5. Selenoprotein W is found in muscle. Although its function is presently unknown, it is thought to play a role in muscle metabolism

6. Selenophosphate synthetase
Incorporation of selenocysteine into selenoproteins is directed by the genetic code and requires the enzyme selenophosphate synthetase. A selenoprotein itself, selenophosphate synthetase catalyzes the synthesis of monoselenium phosphate.

7. Methionine-R-sulfoxide reductase studies revealed that the protein catalyzes stereospecific reduction of oxidized methionine residues in reactions that use thioredoxin as a reductant.

8. Sep15 is mammalian protein located in the endoplasmic reticulum of the cell. Here, it binds UDP-glucose:glycoprotein glucosyltransferase, an enzyme that senses protein folding. Sep 15 has a redox function and is also implicated in cancer prevention

9. Selenoprotein V is expressed exclusively in testes and is thought to function in spermatogenesis.

10. Selenoprotein S is involved in retrotranslocation of misfolded proteins from the endoplasmic reticulum to the cytosol.

This protein may also be involved in inflammatory and immune responses.

Products
All products, laminates, test kits, biomarker, DVDs, Online video education available at

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