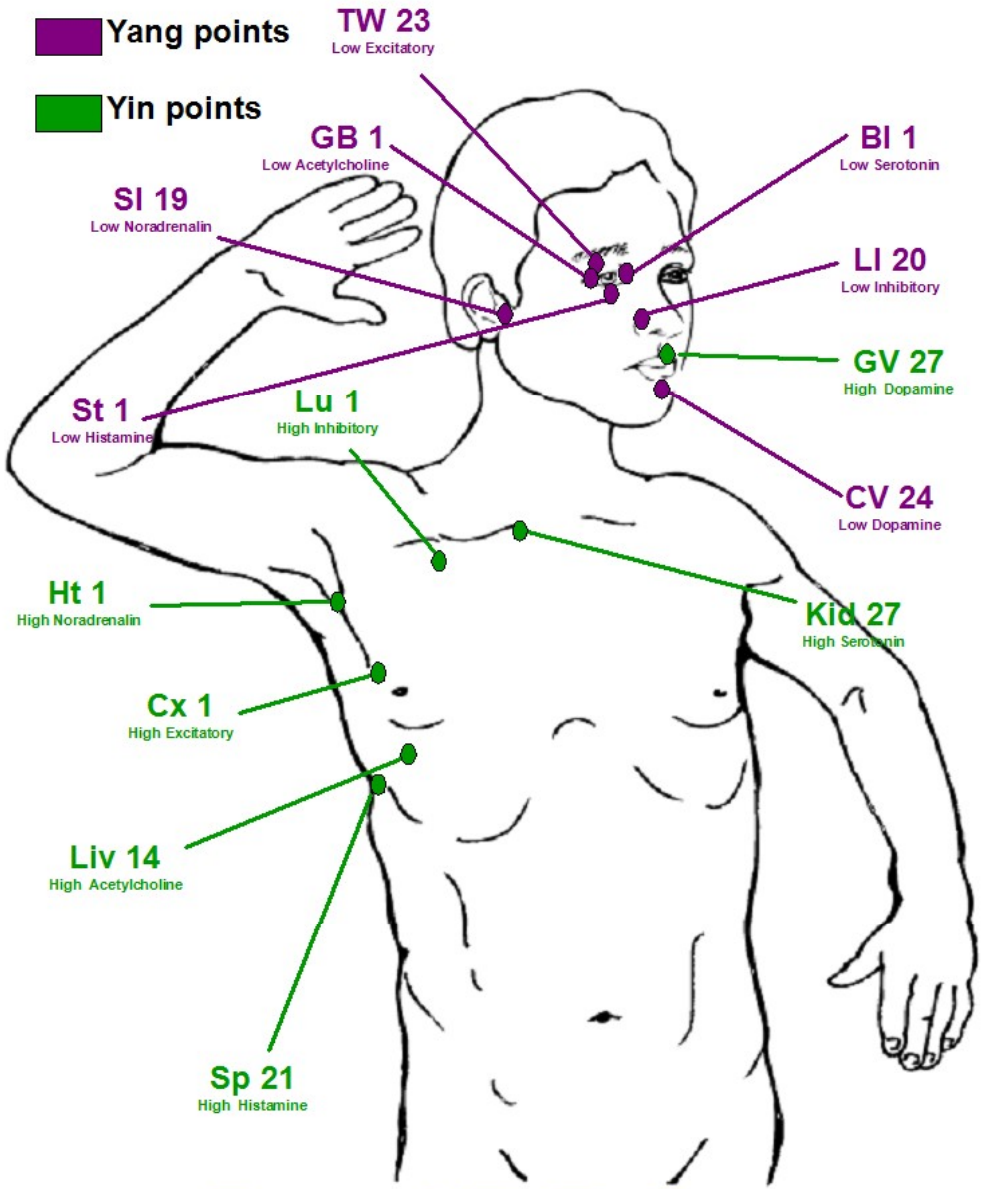
ICAK
Nutrition Course
Neurotransmitters
Module 9

Meridians B&E Points

Yang points begin or end on the face.

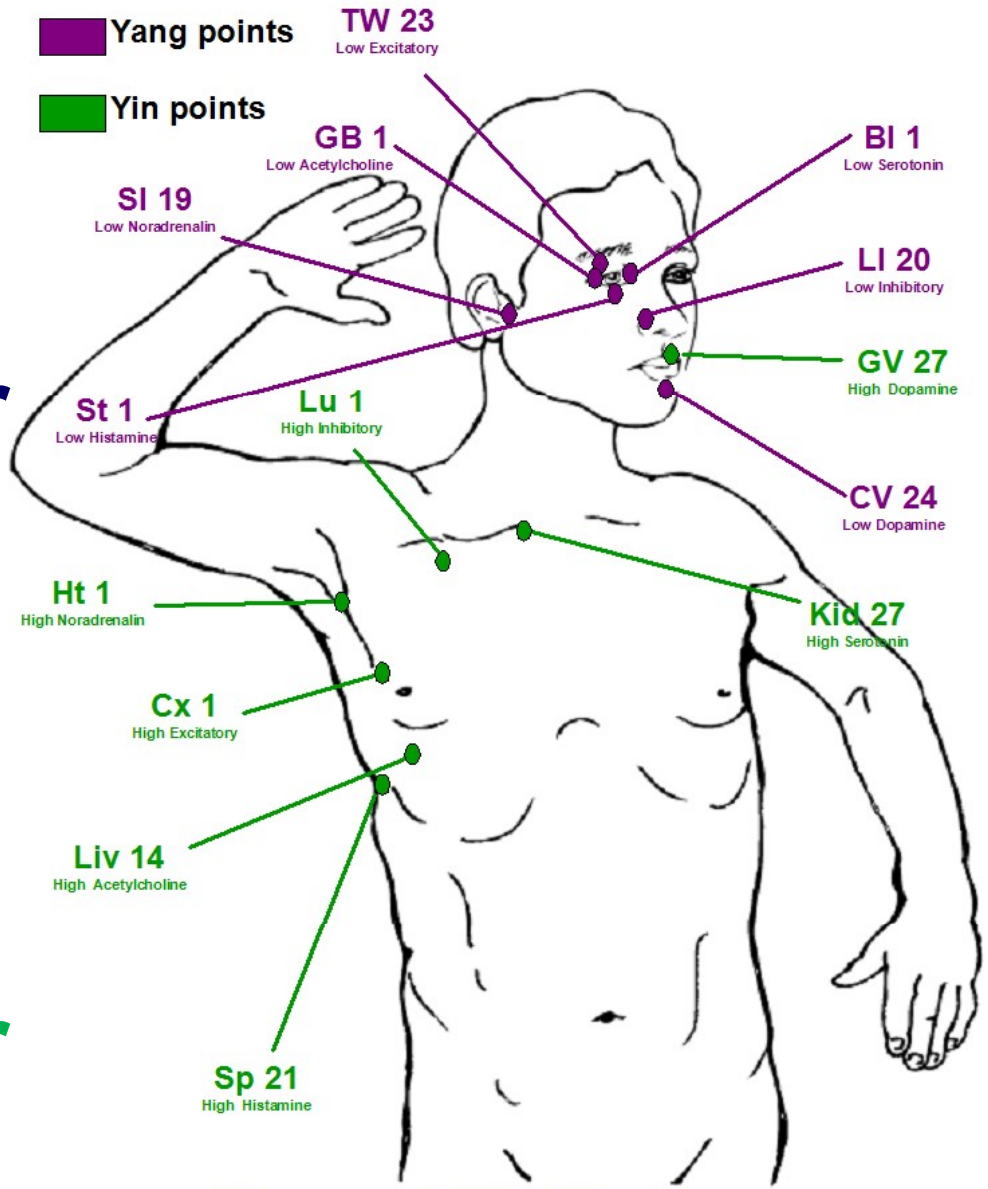
Yin points begin or end on the trunk.



B and E Points

Yang points indicate neurotransmitter deficiencies.

Yin points indicate neurotransmitter excesses



A meridian should be thought of reflecting its physiological function rather than just the organ its named after.

How the Nervous System Communicates

Nerves talk to each other by secreting specific chemicals called neurotransmitters.

The message is transmitted by electricity just like a telephone.

Neurotransmitters are chemicals made by neurons and used by them to transmit signals to the other neurons or non-neuronal cells

(e.g., skeletal muscle, myocardium, pineal glandular cells etc)
that they innervate.

The neurotransmitters produce their effects by being released into synapses when their neuron of origin fires (i.e., becomes depolarized)

and then attaching to receptors in the membrane of the post-synaptic cells.

This causes changes in the fluxes of particular ions across that membrane, making cells more likely to become depolarized, if the neurotransmitter happens to be **excitatory,**
or stimulatory
or less likely if it is **inhibitory.**

Neurotransmitters can also produce their effects by modulating the production of other signal-transducing molecules ("second messengers“ such as cAMP, cGMP, Phosphatidylinositol) in the post-synaptic cells.

Ten compounds -- belonging to three chemical families -- are generally believed to function as neurotransmitters somewhere in the central nervous system or periphery.

Excitatory	**Aspartic acid**
	Glutamic acid
Stimulatory	**Acetylcholine**
	Noradrenalin
	Dopamine
	Serotonin
	Histamine

Inhibitory **GABA, Glycine, Taurine**

In addition, certain other body chemicals, for example

adenosine,

enkephalins,

endorphins,

nitric oxide

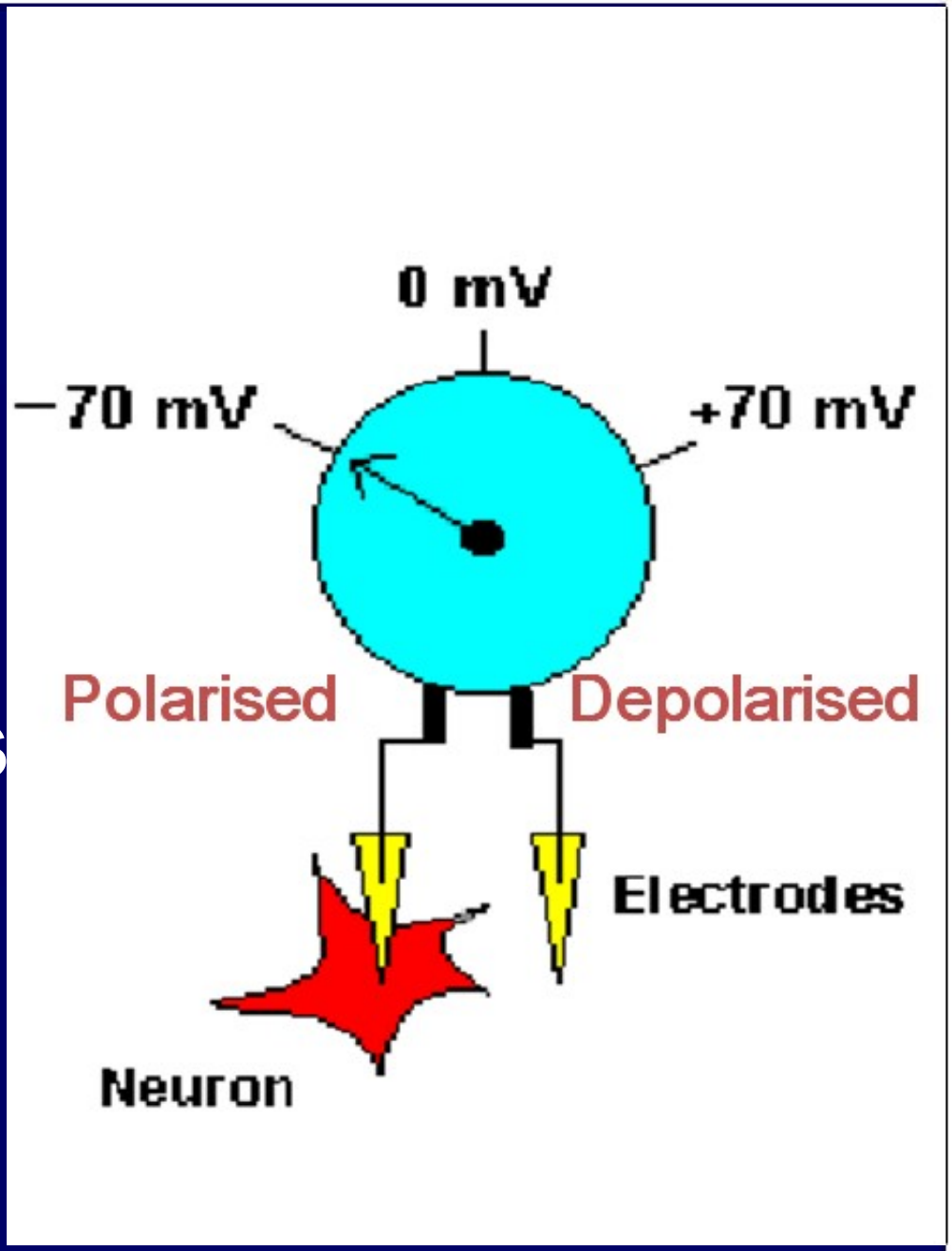
have neurotransmitter-like properties.

Glutamic acid and GABA are the most abundant neurotransmitters within the central nervous system, particularly in the cerebral cortex; glutamic acid tends to be excitatory and GABA inhibitory. Aspartic acid and glycine subserve these functions in the spinal cord.

Once released into the synapse, each neurotransmitter combines chemically with one or more highly **specific receptors**;

these are protein molecules which are imbedded in the post-synaptic membrane.

This interaction can affect the **electrical properties** of the post-synaptic cell, its chemical properties, or both.



When a **Neuron** is in its resting state, it sustains a voltage of about

- 70 milli volts

as the consequence of differences between the concentrations of certain ions at the internal and external sides of its bounding membrane.

Stimulatory neurotransmitters either open protein-lined channels in this membrane, allowing extracellular ions, like

Sodium (Na+)

to move into the cell, or close channels for potassium.

This raises the neuron's voltage towards zero, and makes it more likely that the cell will become depolarized. If the postsynaptic cell happens also to be a neuron (i.e., as opposed to a muscle cell), this depolarization will cause it to release its own neurotransmitter from its terminals.

Inhibitory neurotransmitters like GABA , Glycine and Taurine activate receptors that cause chloride (Cl-) to pass through the membrane;

this usually hyperpolarizes the postsynaptic cell, and decreases the likelihood that it will become depolarized.

The excitatory neurotransmitter glutamic acid, acting via its NMDA receptor, can also open channels for calcium ions (Ca++).

Excessive activation of these receptors in neurological diseases can cause toxic quantities of calcium to enter the cells, and kill them.

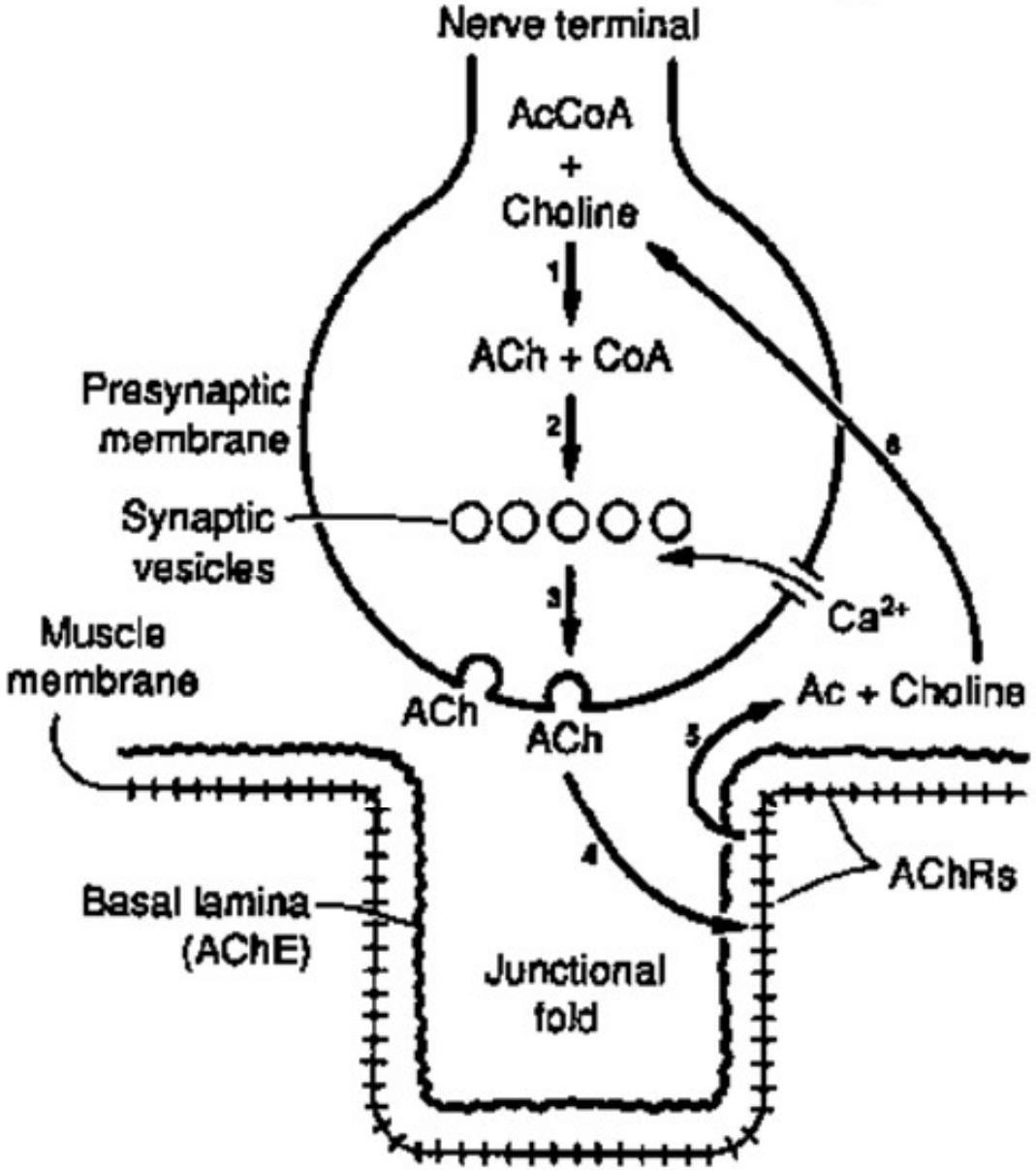
Once neurotransmitters have been secreted into synapses and have acted on their receptors, they are **metabolised** from the synapse either by enzymatic breakdown - for example acetylcholine, which is converted to choline and acetate, neither of which has neurotransmitter activity.

For neurotransmitters like

Dopamine
Serotonin
GABA

a physical process called reuptake takes place.

Terminal end of a cholinergic neuron



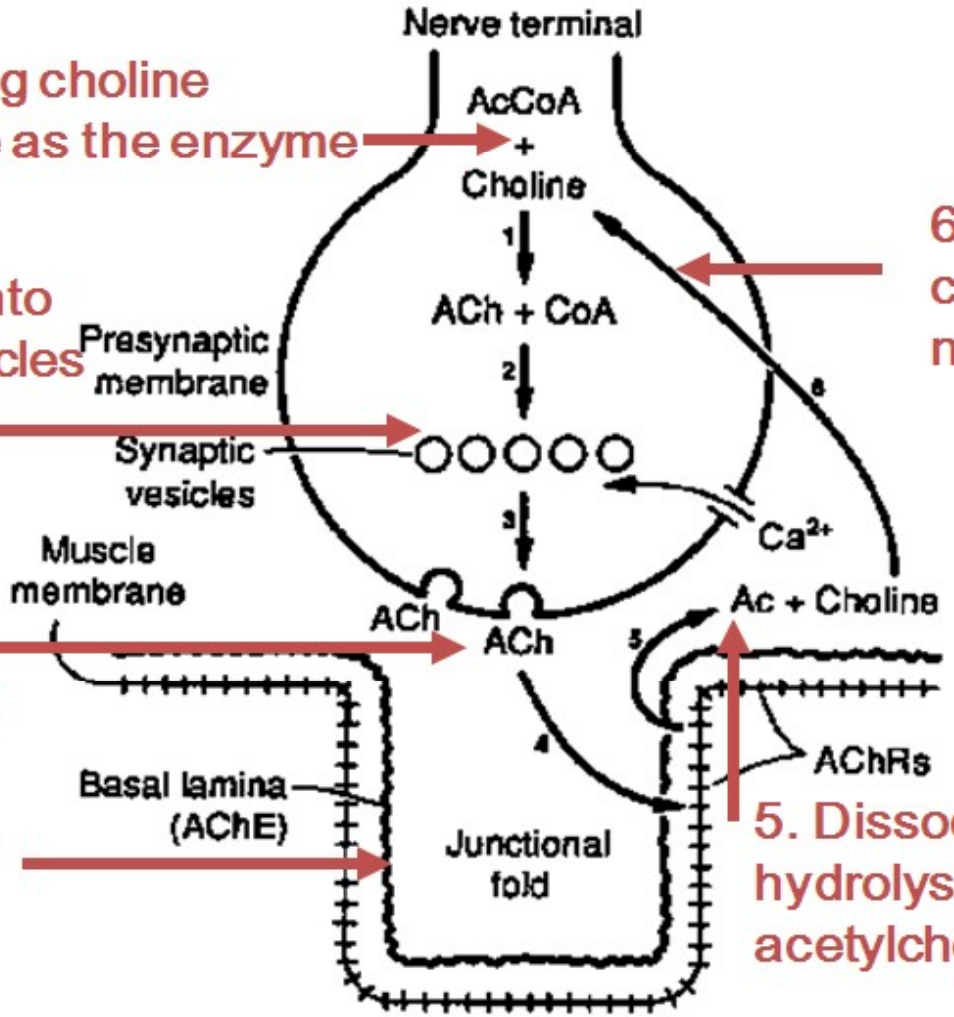
Neurotransmitter synthesis

1. Synthesis using choline acetyltransferase as the enzyme

2. Incorporation into the synaptic vesicles and stored

3. Release of acetylcholine from the vesicles

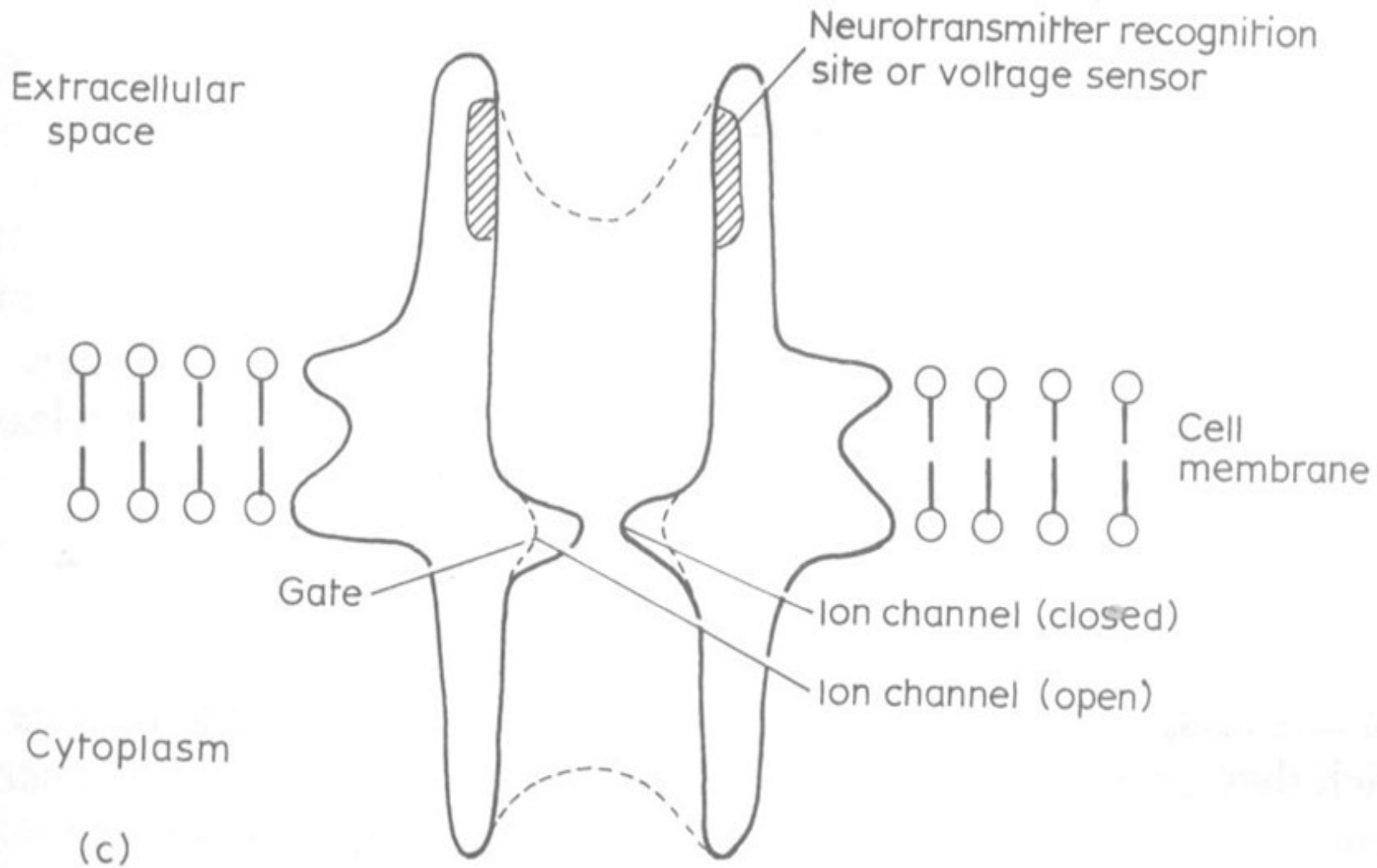
4. Diffusion to its receptors in the junctional folds



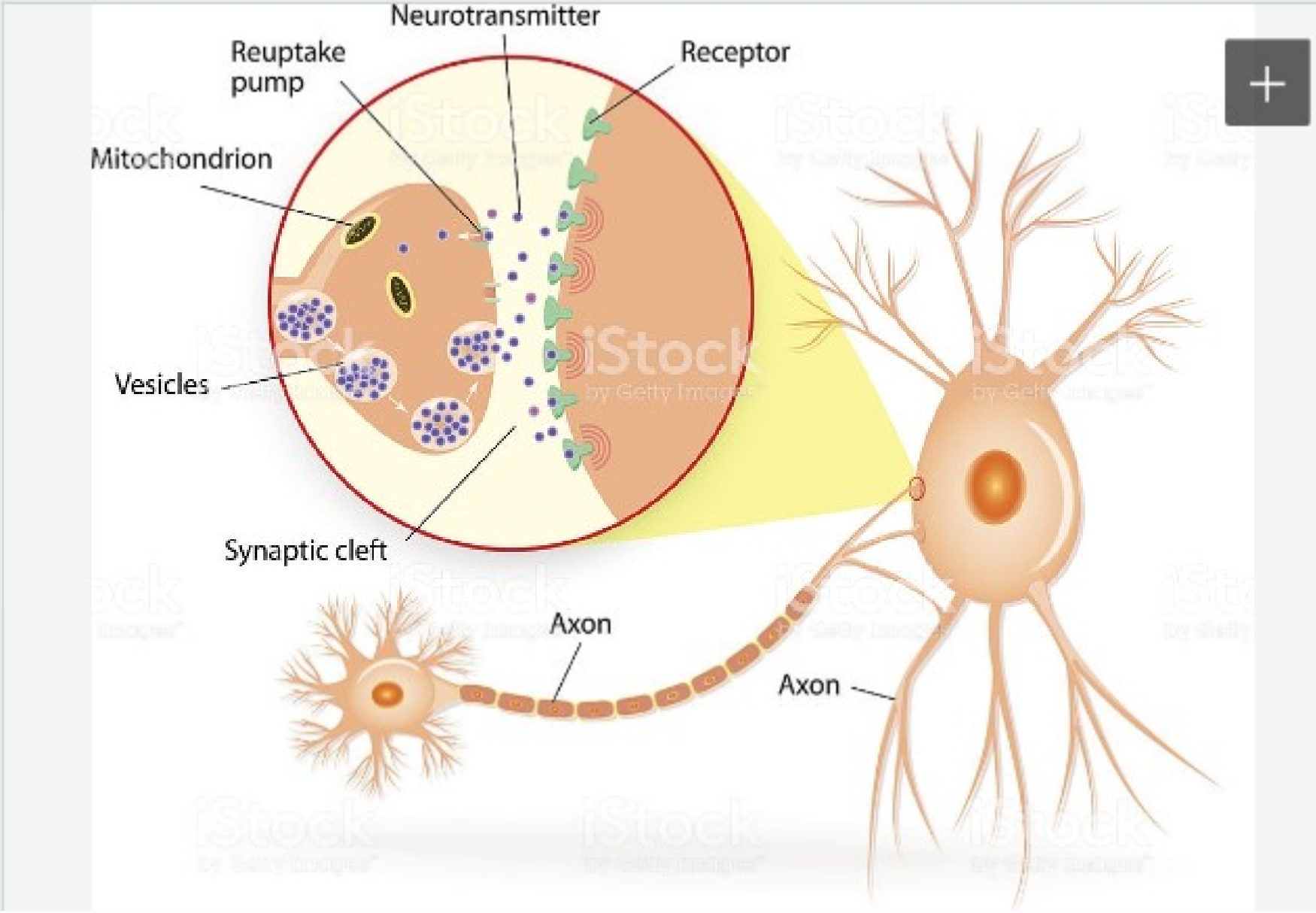
6. Recycling of choline into the nerve terminal

5. Dissociation and hydrolysis by acetylcholinesterase

Receptors are like molecular ears



Structure of a typical chemical synapse - Illustration



Neuronal membranes

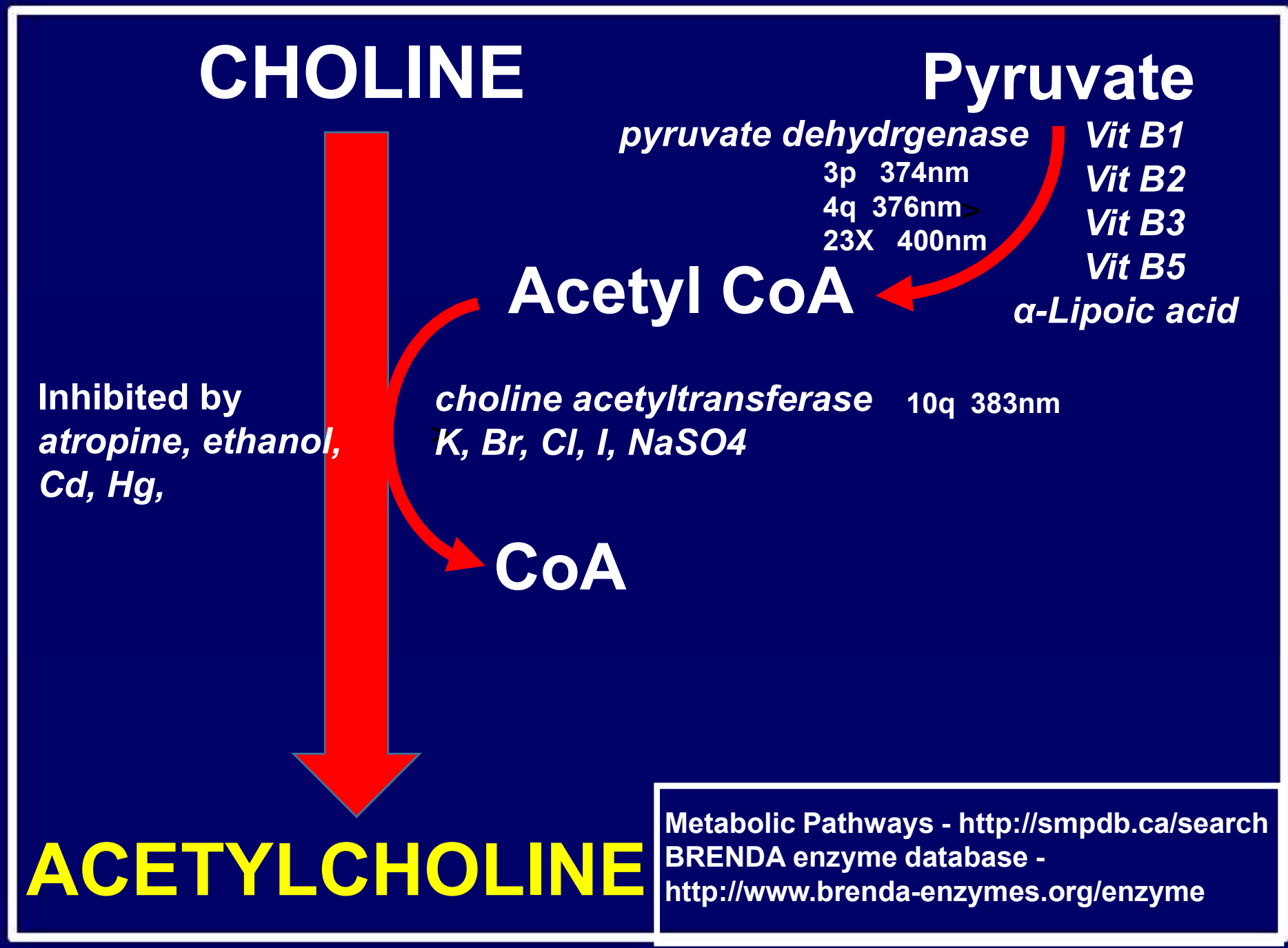
The lipid portion of cell membranes is just 3 nanometres thick.

If you were to stack sheets of them one upon the other – it would take 10,000 membranes to make up the thickness of a piece of paper.

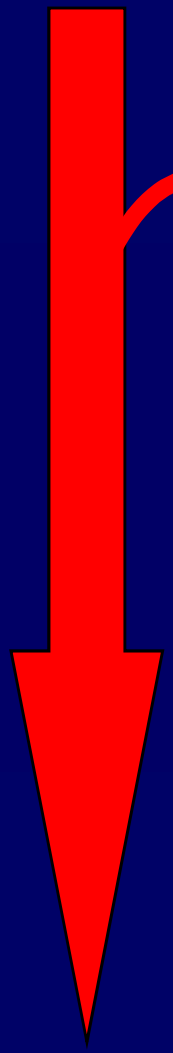
Neurotransmitters

All enzyme Co-enzymes, Co-factors, Inhibitors and Activators verified in BRENDA Enzyme database

Acetylcholine


CHOLINE
Pyruvate
pyruvate dehydrgenase
3p 374nm
4q 376nm
23X 400nm
Vit B1
Vit B2
Vit B3
Vit B5
α-Lipoic acid
Acetyl CoA
Inhibited by
atropine, ethanol,
Cd, Hg,
choline acetyltransferase 10q 383nm
K, Br, Cl, I, NaSO4
CoA
ACETYLCHOLINE
Metabolic Pathways - http://smpdb.ca/search
BRENDA enzyme database -
http://www.brenda-enzymes.org/enzyme

ACETYLCHOLINE



Inhibited by
Chemicals – pesticides solanine, sodium fluoride thyme, galantamine, huperzine aspartame, aspartate, phenylalanine lovastatin melatonin , methotrexate, phos serine, diazepam, eugenol, insulin, limonene Toxic metals Cd, Cu, Hg, Sn, Radiation

H_2O

acetylcholinesterase

7q 380nm

B2

B3

Mn++

Zn++ Cysteine

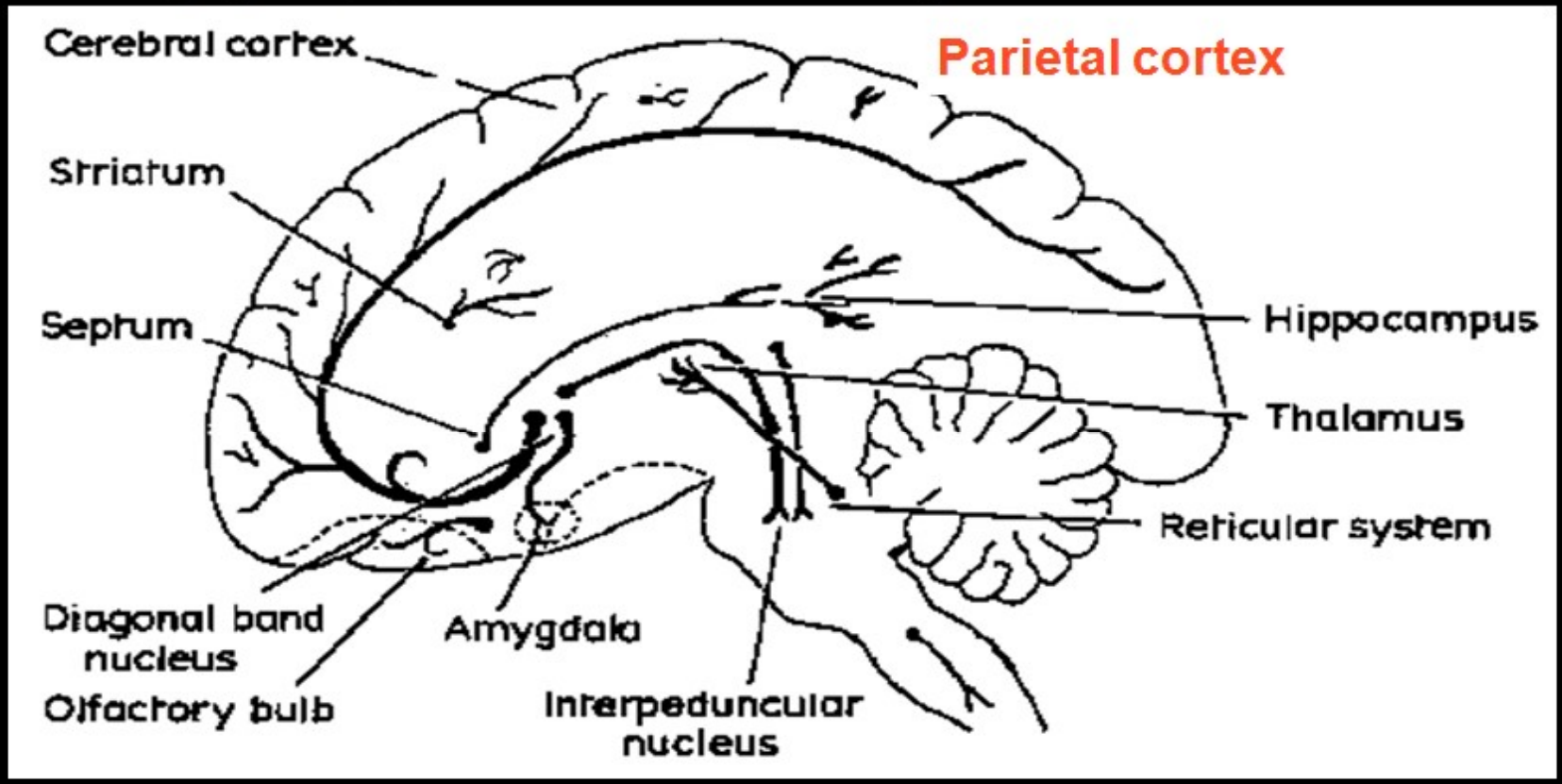
Recycled

Acetate + Choline

Metabolic Pathways - http://smpdb.ca/search
BRENDA enzyme database - http://www.brenda-enzymes.org/enzyme

Acetylcholine is the transmitter at

1. All preganglionic nerve terminals (both parasympathetic and sympathetic) of the autonomic nervous system
2. All postganglionic parasympathetic nerve terminals
3. The neuromuscular junction of voluntary muscles
4. The adrenal medulla
5. Parts of the central nervous system especially the hippocampus
6. Postganglionic sympathetic nerve terminals at sweat glands.



Acetylcholine Receptors

1. Muscarine from the fungus Amanita muscaria. The effect of muscarine is tearing eyes, pupillary constriction, profuse sweating, drooling saliva, faecal dribbling or explosion from the anus. Painful peristalsis, low blood pressure and bradycardia. Antagonised by atropine.

Acetylcholine Receptors

1. Muscarine receptor stimulation occurs physiologically when the parasympathetic nervous system is active during rest and sleep.

i) Slows the heart rate

ii) Stimulates the release of NO in blood vessels and so vasodilates

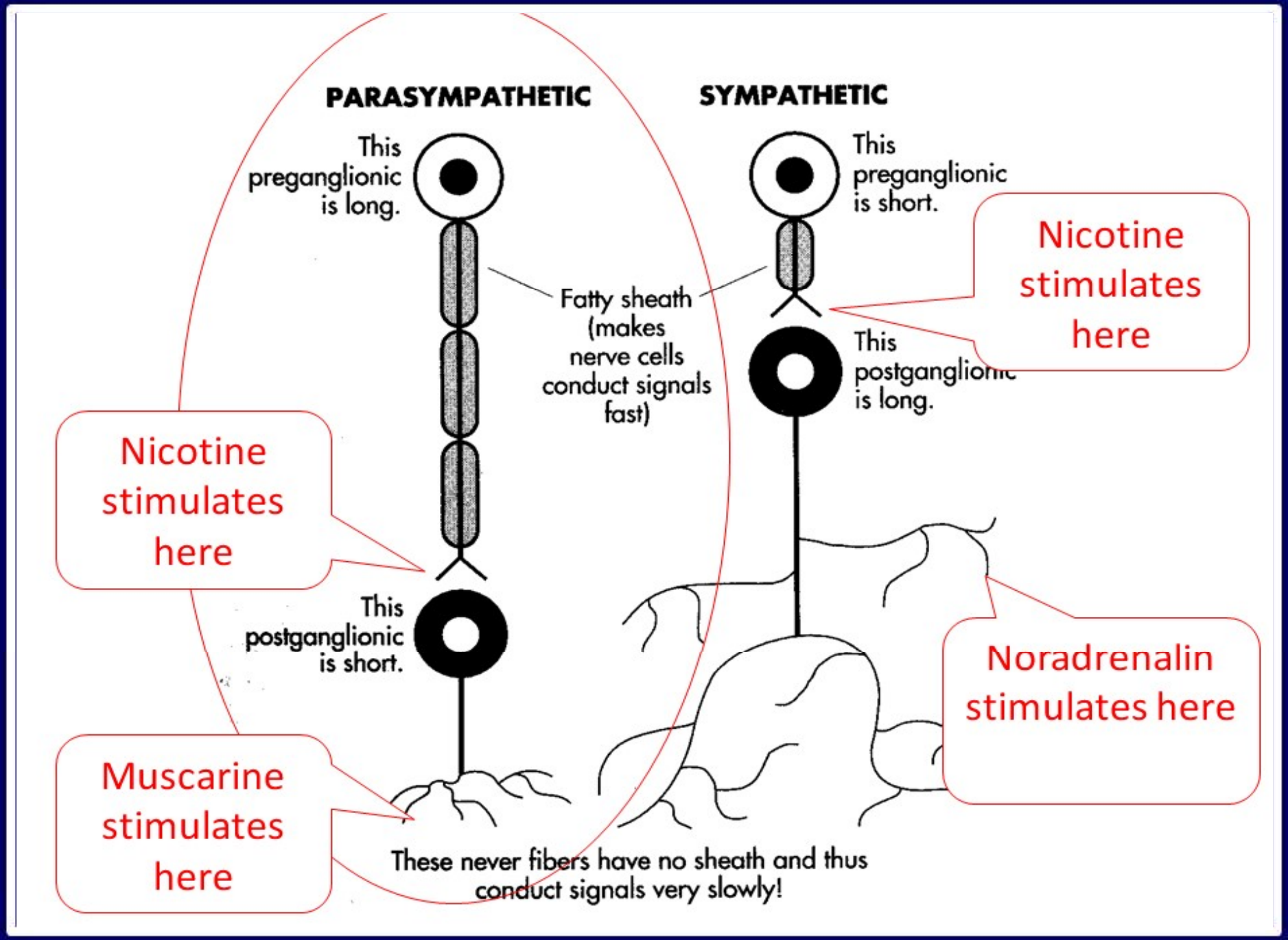
iii) Stimulates the secretion of saliva, mucous, HCl, digestive enzymes and skin sweat glands.

iv) Stimulates intestinal tone and peristalsis.

v) Stimulates ureter and bladder contraction.

vi) Stimulates cilary muscle contraction in the eye causing relaxation of the lens, which is then focused for near vision. Stimulates contraction of the iris circular muscles causing constriction of the pupil. Stimulates reduction of the intra ocular pressure by better drainage through the canal of Schlemm.

Neurotransmitters and Drugs by Z. Kruk and C. Pycock. pg



Neurotransmitters and Drugs by Z. Kruk and C. Pycock. pg

2. Nicotinic (antagonised by curare) receptors occur at

i) CNS especially in the hippocampus.

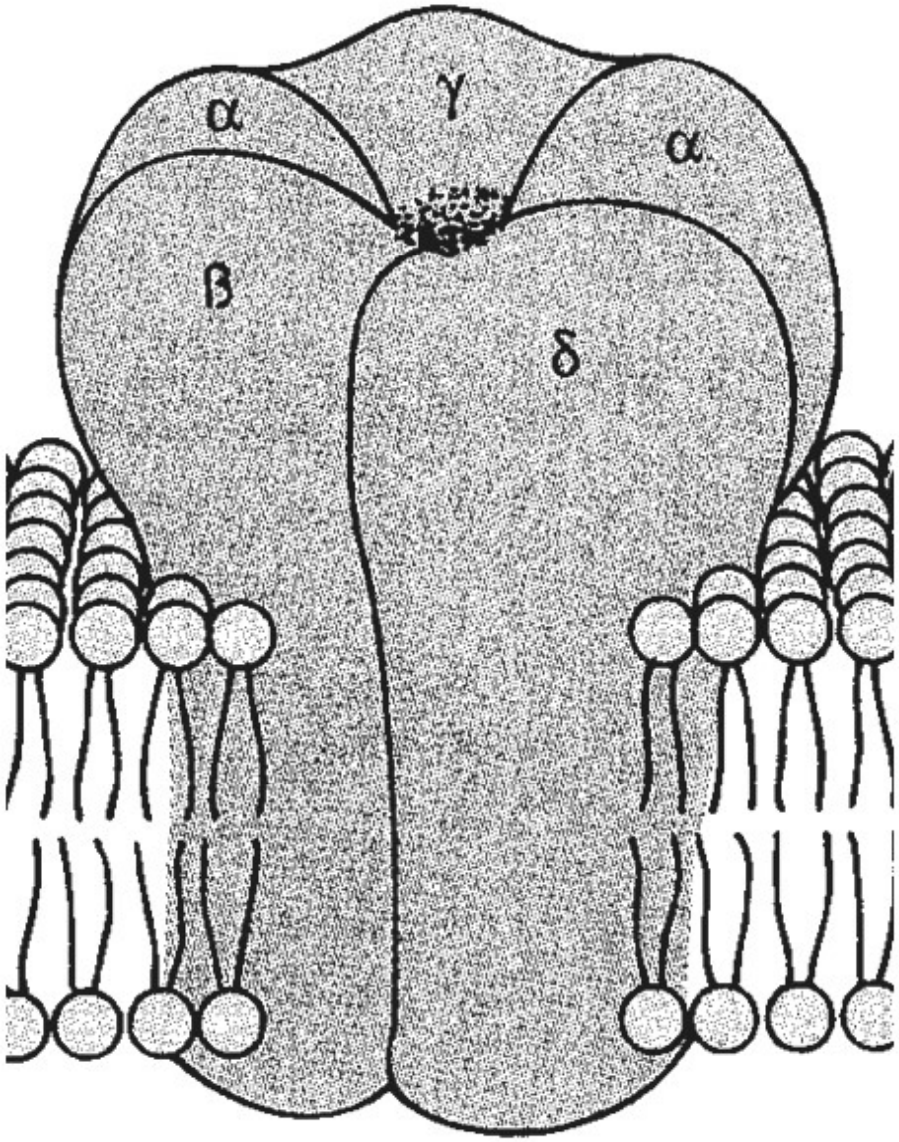
ii) The neuromuscular junctions

Neurotransmitters and Drugs by Z. Kruk and C. Pycock. pg

Acetylcholine is possibly the most widely used neurotransmitter in the body, and all axons that leave the central nervous system (for example, those running to skeletal muscle, or to sympathetic or parasympathetic ganglia) use acetylcholine as their neurotransmitter.

Neurotransmitters and Drugs by Z. Kruk and C. Pycock. pg

Acetylcholine Receptors

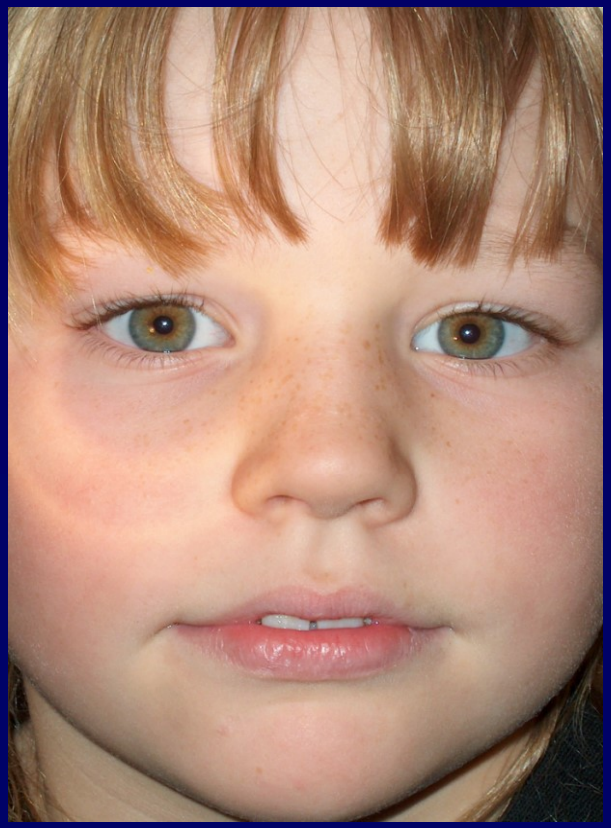


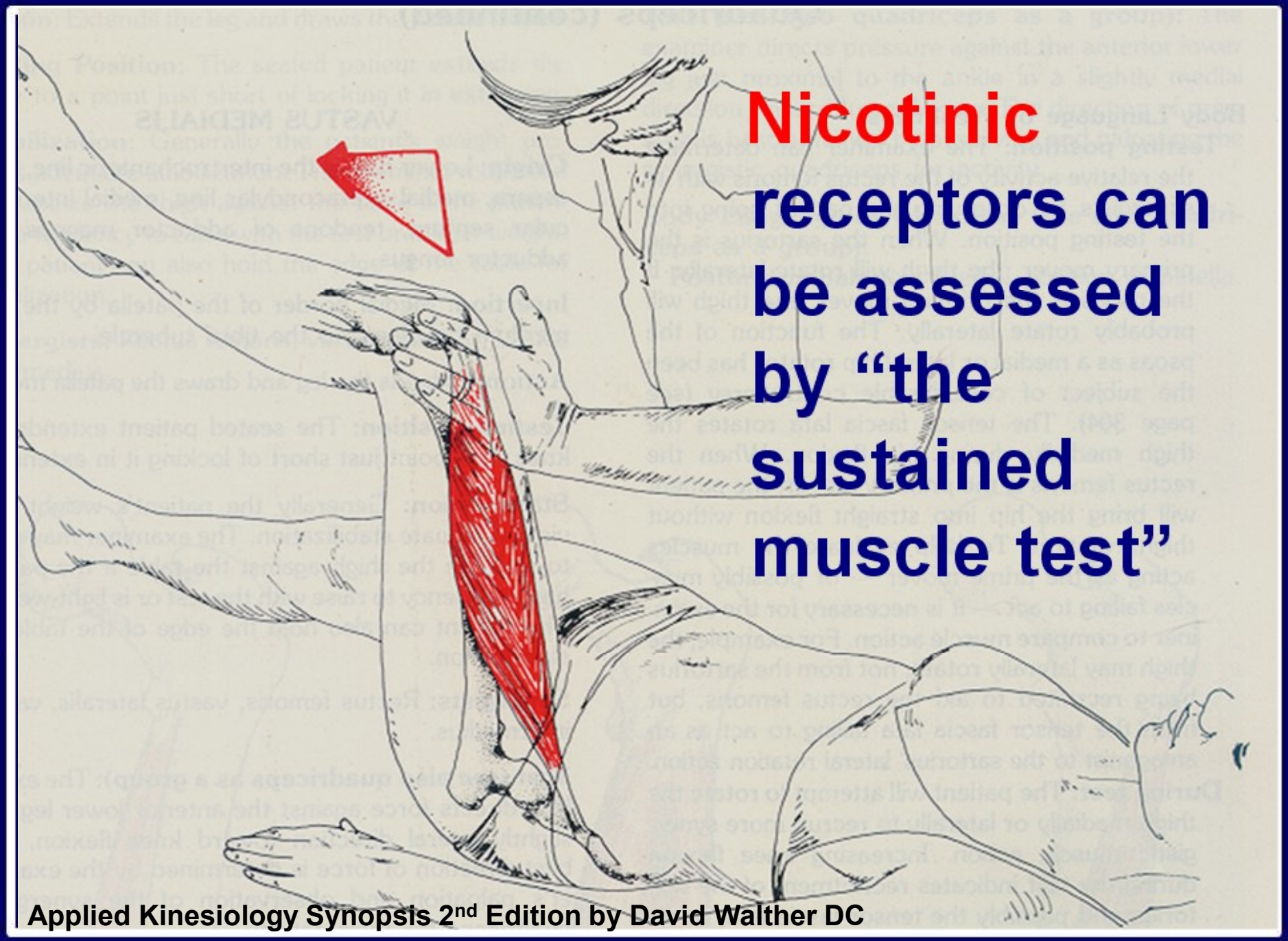
1. **Muscarine receptors** occur in the parasympathetic nervous system

2. **Nicotinic receptors** occur at
   i) CNS especially in the hippocampus.
   ii) The neuromuscular junctions

Neurotransmitters and Drugs by Z. Kruk and C. Pycock. pg

Muscarinic receptors can be assessed by "the looking into a bright light" test.





Applied Kinesiology Synopsis 2nd Edition by David Walther DC

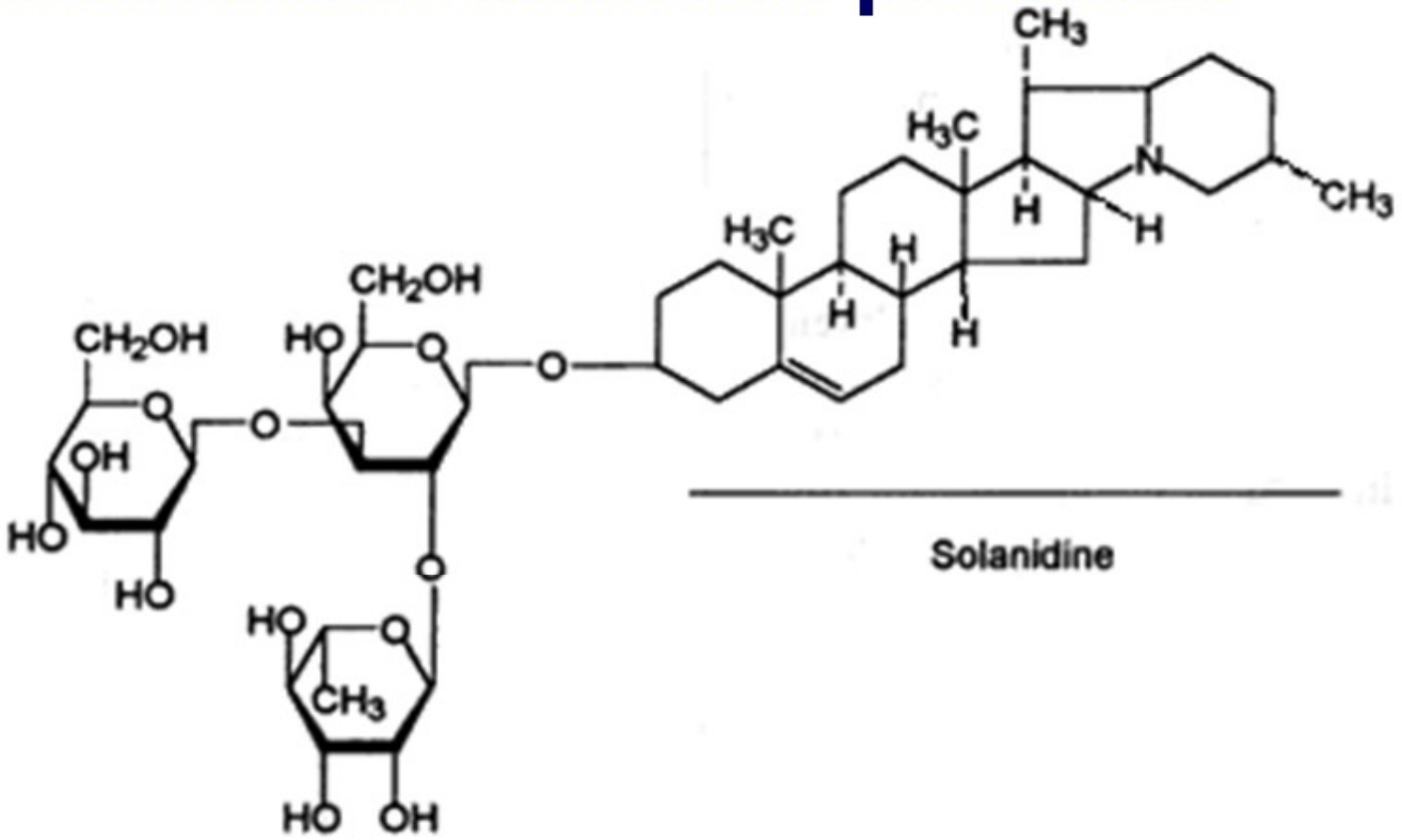
Anticholinergics

Solanacea family

- Tomatoes
- Potato
- Tobacco
- Green peppers
- Chilli

Alpha-Solanine

Solanine is one of the main glycoalkaloids found in potatoes.



α-Solanine

Natural Acetylcholinesterase Inhibitors

Galantathine
(Galanthamine)

Snowdrops
Daffodils
Lemon balm

Lemon balm

Melissa officialis

In a study done in 2003 at Nottingham University researchers investigating the use of Lemon balm for both mood elevation and cognitive performance in healthy volunteers aged18-22 years, found that a low dose of 500mg a day was much more effective than taking either 800mg and suggested best taking the dose twice a day.

Lemon balm

Tincture low dose	↑Calmness
Tincture high dose	↑ Memory
Powder low dose	↑ Memory
Powder high dose	↑ Calmness

High dose Powder also increased secondary memory.

Limonene – a powerful ACh-E inhibitor

Rosemary

Black walnut

Fennel

Sun, J. (2007). "D-Limonene: safety and clinical applications“ (PDF). *Alternative Medicine Review*. 12 (3): 259–264.

Recent research has shown that **Sage (Salvia)** oil (50-150mg) can inhibit acetylcholinesterase improving memory recall by 8%. (Probably due to a high limonene concentration).

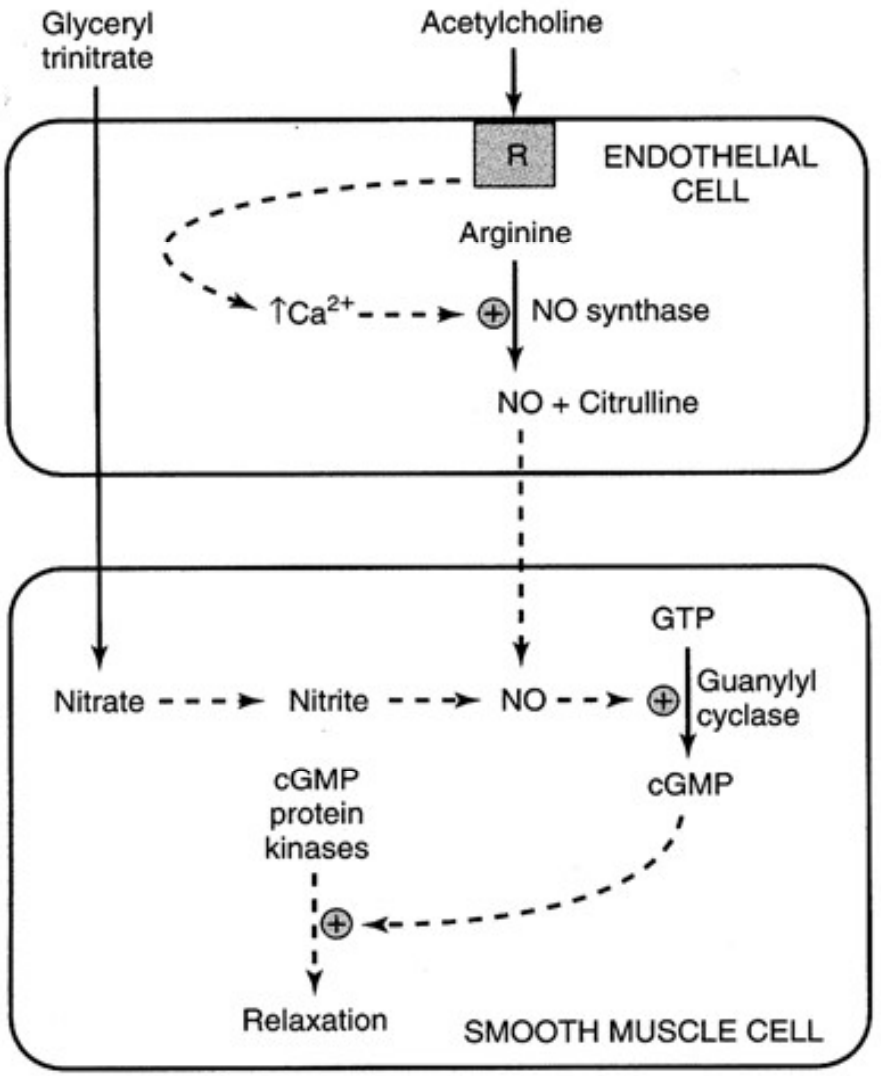
Medicinal Plant Research Centre, University of Newcastle and Northumberland August 2003

Many of the current drugs that inhibit acetylcholinesterase such as “Donepezil” have unpleasant side effects.

No side effects were noted in the sage trial, details of which are published in the journal “Pharmacology and Biochemistry”.

Lopresti AL (2017). "Salvia (Sage): A Review of its Potential Cognitive-Enhancing and Protective Effects". Drugs in R&D. 17(1): 53–64.

Possible mechanism by which **lemon balm and sage** may improve memory by increasing cerebral circulation.



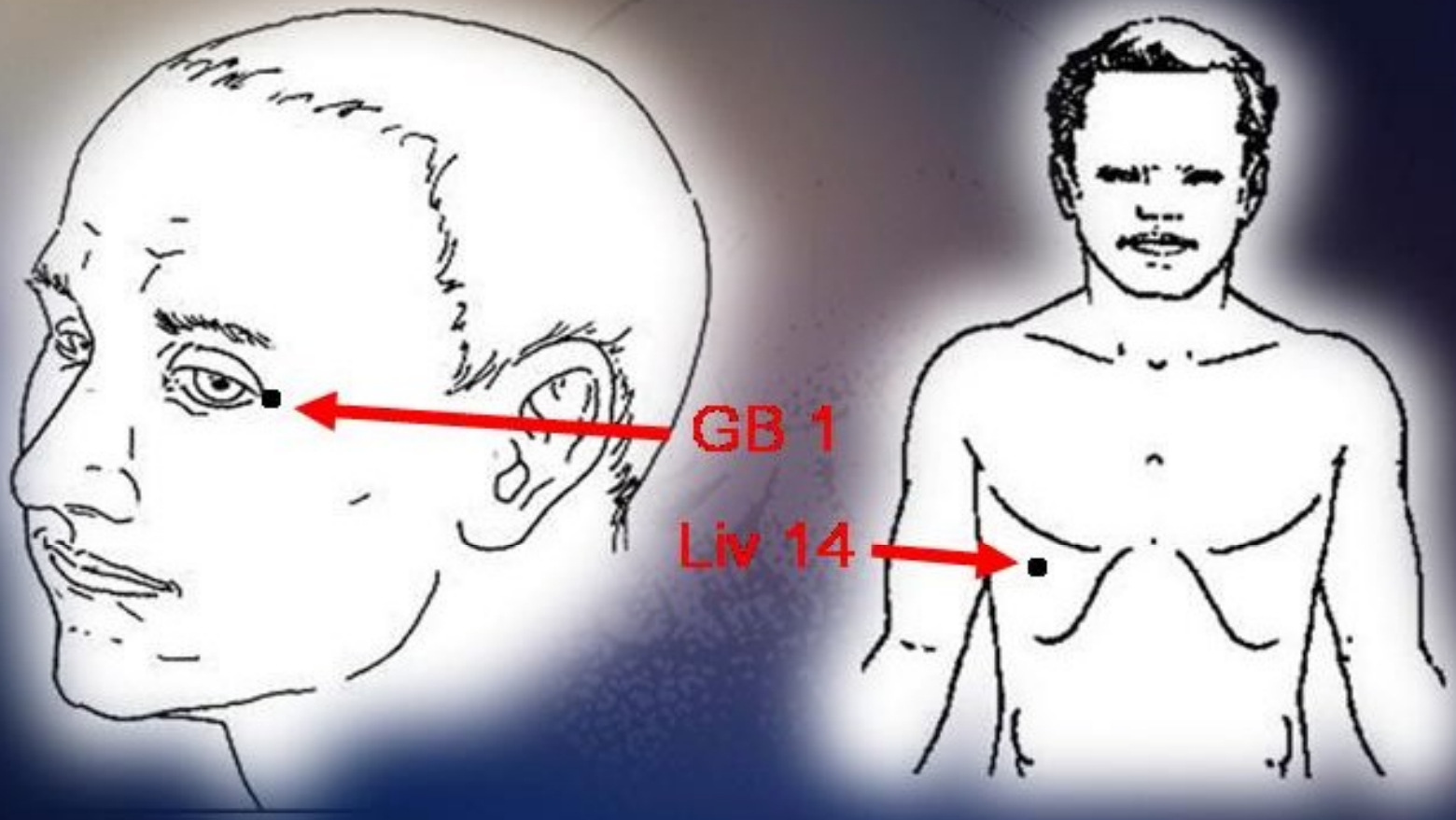
Harper's Illustrated Biochemistry 29th Edition Pub Lange. Page 622

SYMPTOMS

DEFICIENCY	EXCESS
Guilt and Blame	*Pride and Scorn*
↓ NK cell activity	↑ NK cell activity
Tachycardia, Hypertension	Aggressive behaviour
Dry mouth, Poor digestion	Panic attacks (fear paralysis)
Constipation,Urinary retention	Bradycardia
Long sight (hypermetropia)	Hypotension leading to vertigo
Glaucoma, Myesthenia gravis	Excess salivation
Hypercholesteroleamia	Fast transit time, nausea, vomiting, diarrhoea
Inhibition of short term memory.	Involuntary micturition
Confusion. Delirium	Asthma from excess mucous
Hallucinations	Resting tremor and rigidity
Alzheimer's	Liver toxicity

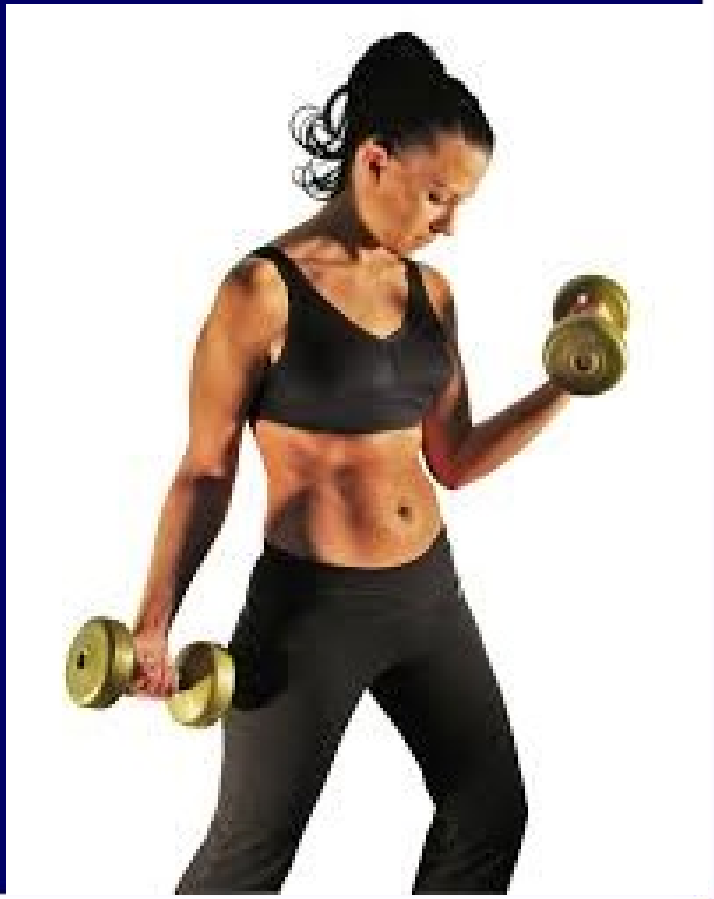
ACETYLCHOLINE MERIDIAN DIAGNOSTIC POINTS

YANG POINTS (DEFICIENCY) YIN POINTS (EXCESS)



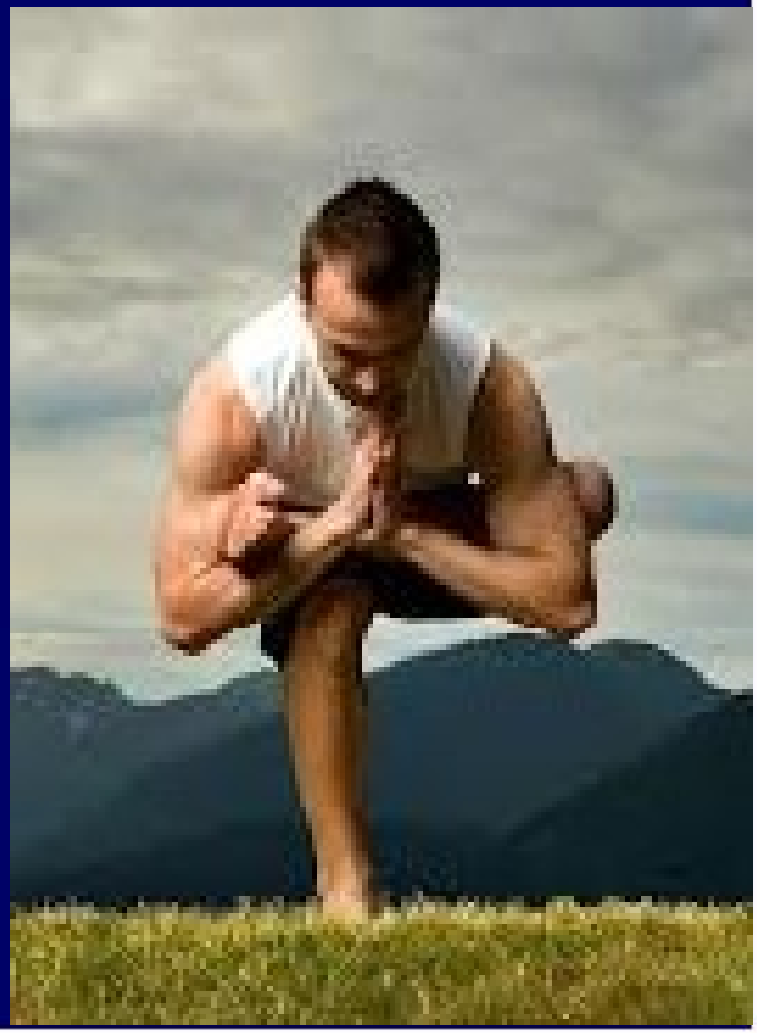
Exercises to stimulate Acetylcholine

Resistance / Weight training

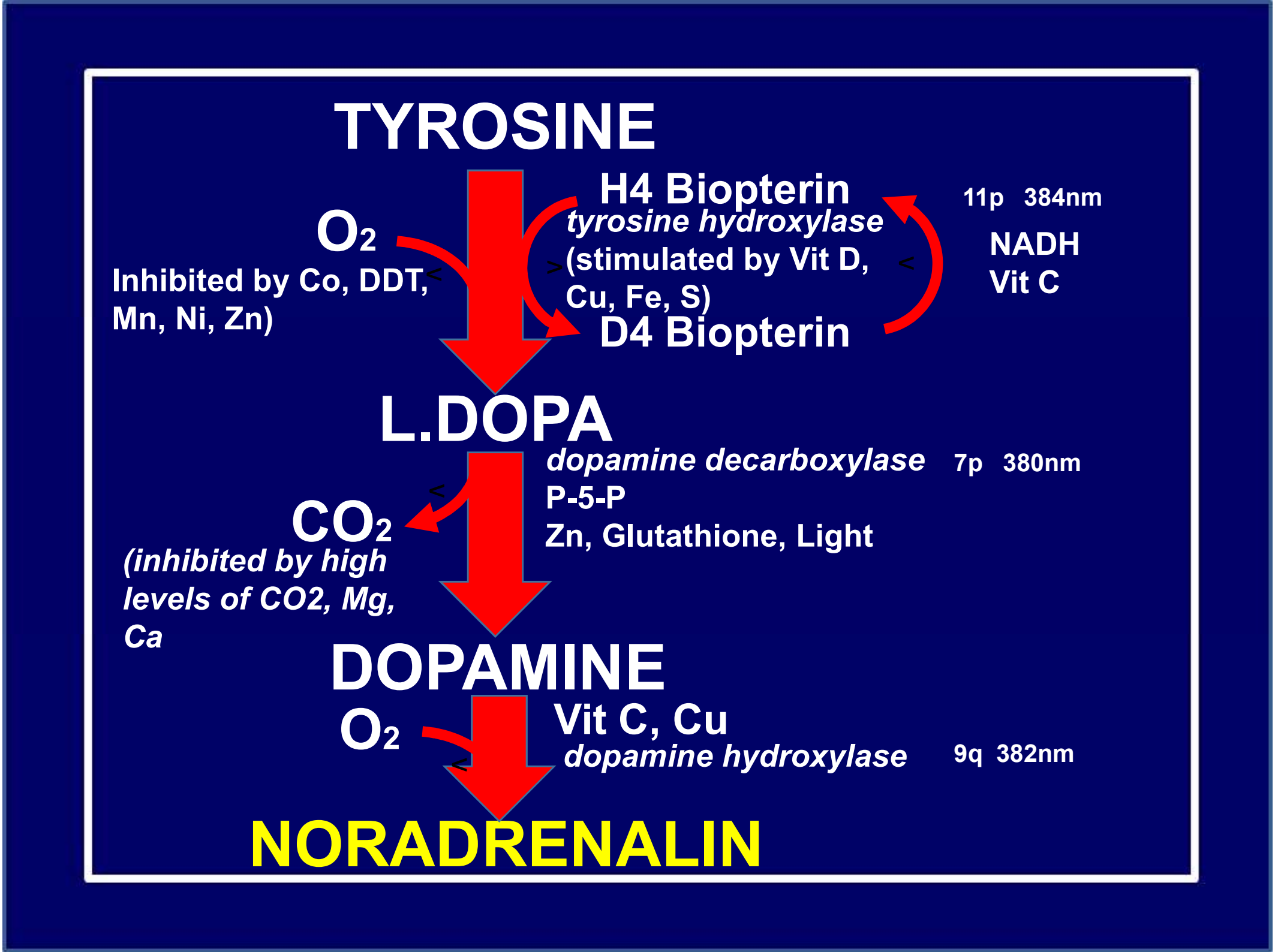


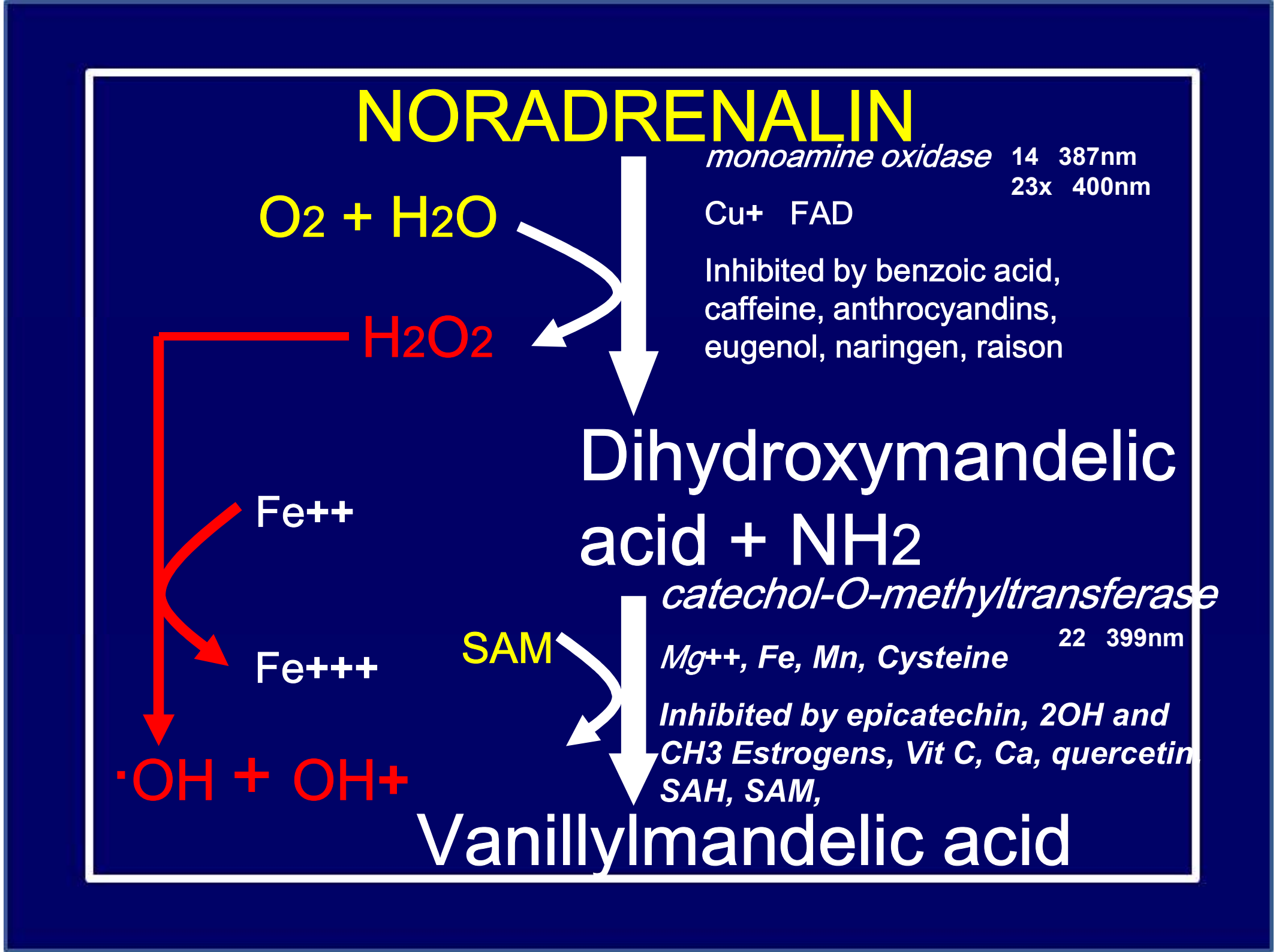
Exercises to inhibit Acetylcholine

Yoga, stretching tight muscles to loosen up.

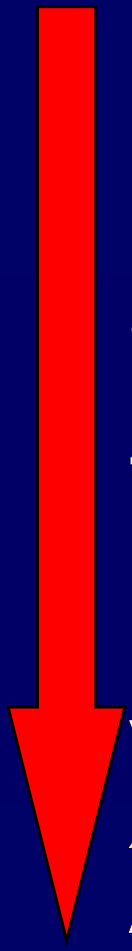


Noradrenalin (Norepinephrine)


TYROSINE
H4 Biopterin
tyrosine hydroxylase
(stimulated by Vit D, Cu, Fe, S)
D4 Biopterin
11p 384nm
NADH
Vit C
O2
Inhibited by Co, DDT, Mn, Ni, Zn)
L.DOPA
dopamine decarboxylase
P-5-P
Zn, Glutathione, Light
7p 380nm
CO2
(inhibited by high levels of CO2, Mg, Ca
DOPAMINE
O2
Vit C, Cu
dopamine hydroxylase
9q 382nm
NORADRENALIN


NORADRENALIN
monoamine oxidase 14 387nm
23x 400nm
O2 + H2O
Cu+ FAD
Inhibited by benzoic acid, caffeine, anthrocyandins, eugenol, naringen, raison
H2O2
Dihydroxymandelic acid + NH2
Fe++
catechol-O-methyltransferase
22 399nm
SAM
Fe+++
Mg++, Fe, Mn, Cysteine
Inhibited by epicatechin, 2OH and CH3 Estrogens, Vit C, Ca, quercetin SAH, SAM,
·OH + OH+
Vanillylmandelic acid

Vanillylmandelic acid



Glutathione (Cysteine, Glycine, Glutamic acid) NAC, Zn++, P5P, Sel

a-Lipoic or

Sulfation (PAPs) S, MSM

Taurine or

Glucuronidation (UDP Gucuronic acid) Glucuronate, Vit C, or

Acetylation (Acetyl CoA) B5, Acetyl CoA

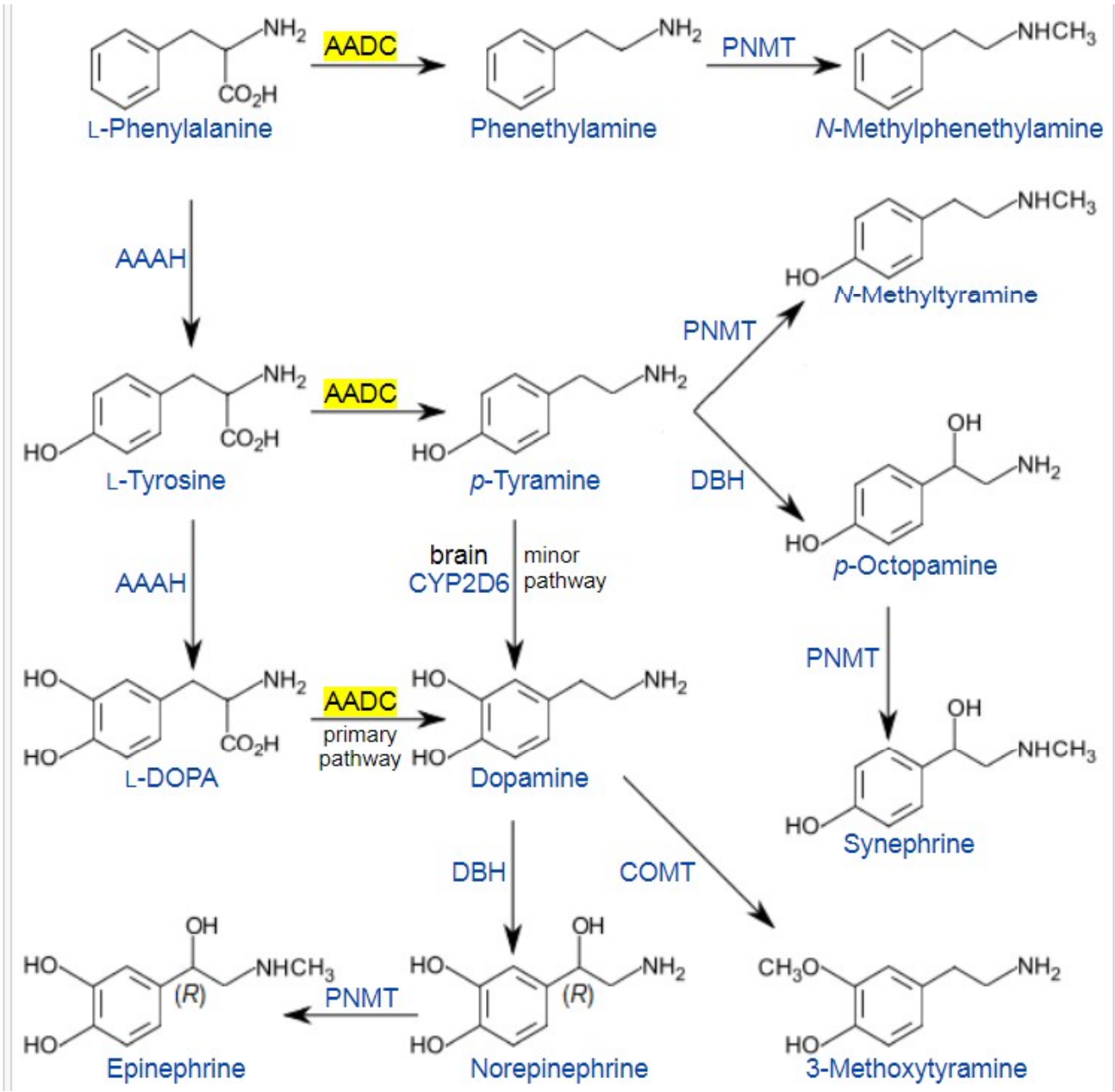
Conjugates excreted through the bile or urine

PNMT = Phenylethanolamine N methyltransferase

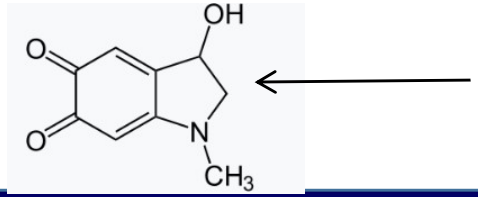
AADC = Aromatic L-amino acid decarboxylase

DBH = Dopamine beta-hydroxylase

COMT = Catechol –O-methyl transferase

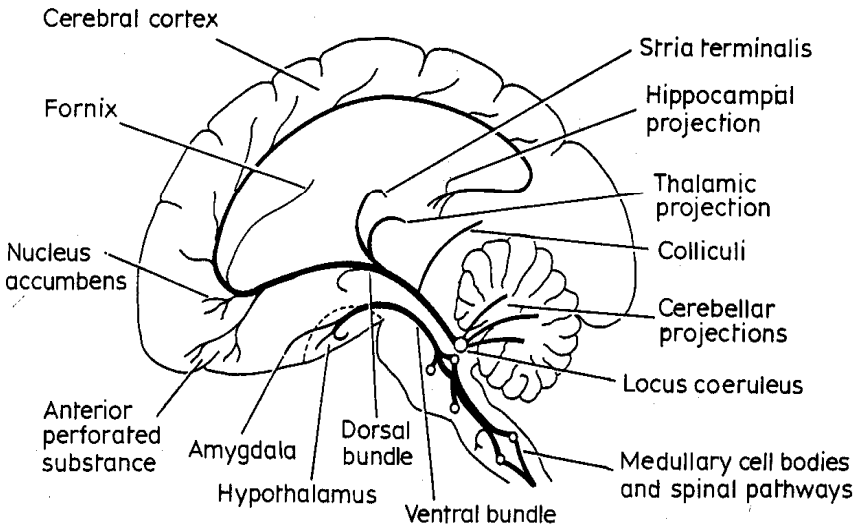


Adrenochrome



Noradrenalin is a neurotransmitter at

1. **Postganglionic sympathetic nerves**
2. The Brain stem
3. Some spinal pathways
4. The Pontine – thalamic, hypothalamic, limbic, hippocampus and neocortex tracts.



Neurotransmitters and Drugs by Z. Kruk and C. Pycock. pg

Adrenoreceptors

Two sub-types designated alpha and beta.

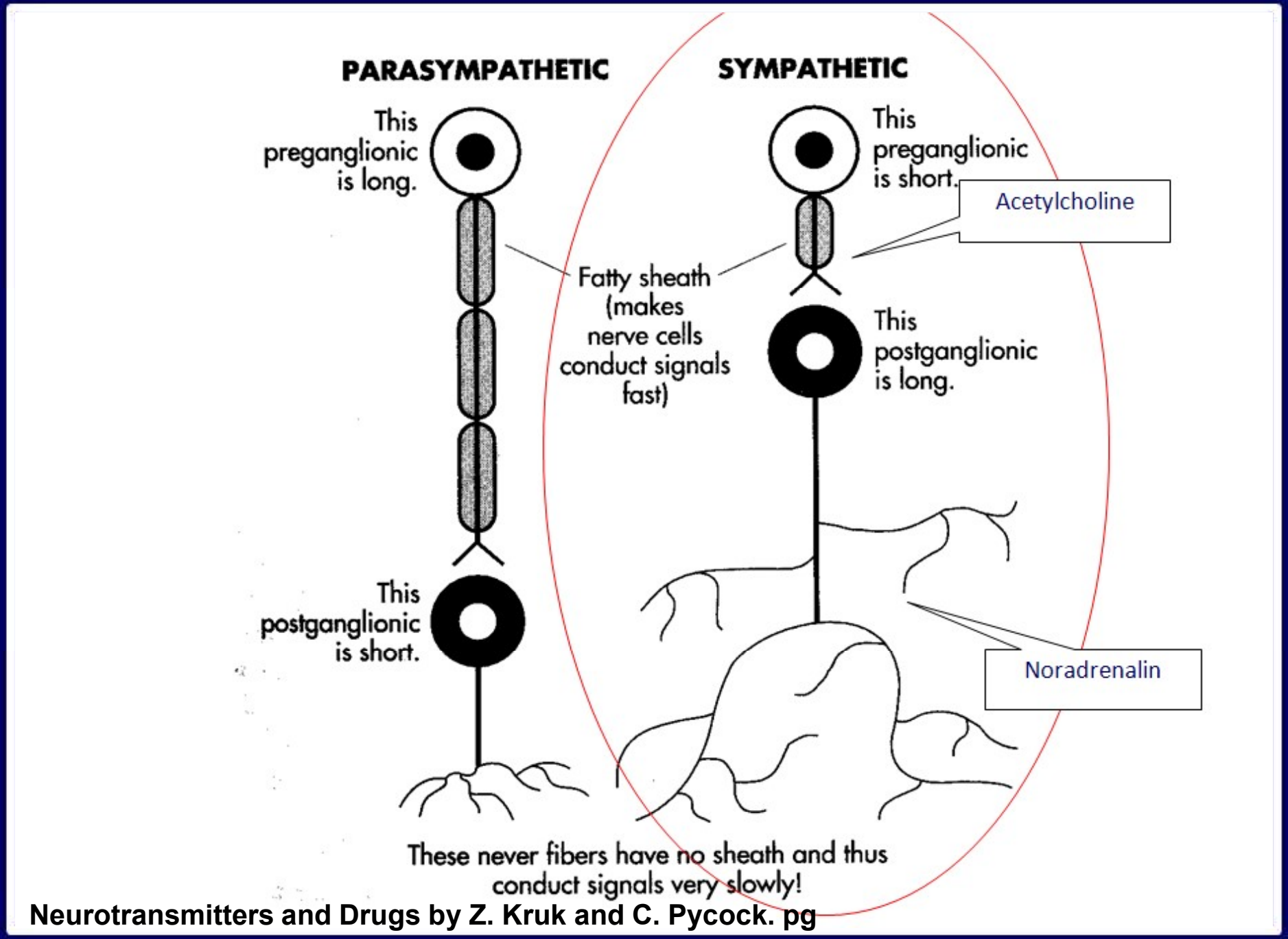
Alpha 1 receptors are found postsynaptically.

Alpha 2 receptors are found in presynaptic autoreceptors, postsynaptically and in the CNS.

Post synaptic effects

i) Contraction of the radial muscles of the iris leading to papillary dilation. Also keeps the eyelid open.
ii) Vasoconstriction.
iii) GI smooth muscle relaxation but sphincter contraction.
iv) Seminal vesicle and vas deferens contraction.
v) Constriction of trigone and bladder sphincter

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.



Neurotransmitters and Drugs by Z. Kruk and C. Pycock. pg

Beta 1 receptors are found in the heart and increases force and contraction.

Beta 2 receptors cause

i) Skeletal muscle and liver vasodilation

ii) Brochodilation.

iii) GI smooth muscle relaxation.

iv) Relaxation of the uterus in pregnancy.

v) Relaxation of the bladder detrusor muscles.

vi) Release of renin causing hypertension

vii) Stimulates glycogenolysis, lipolysis and hypoinsulinism.

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

Noradrenalin enhances

Alertness,

Arousal

and Mood

Noradrenaline (NA) is secreted by many neurones in the brain stem and hypothalamus. Neurones in the locus ceruleus in the pons send fibres to many areas of the brain and help to regulate the overall activity and mood of the ***mind***.

NA has both stimulatory and inhibitory actions.

Noradrenalin is the neurotransmitter released by sympathetic nerves

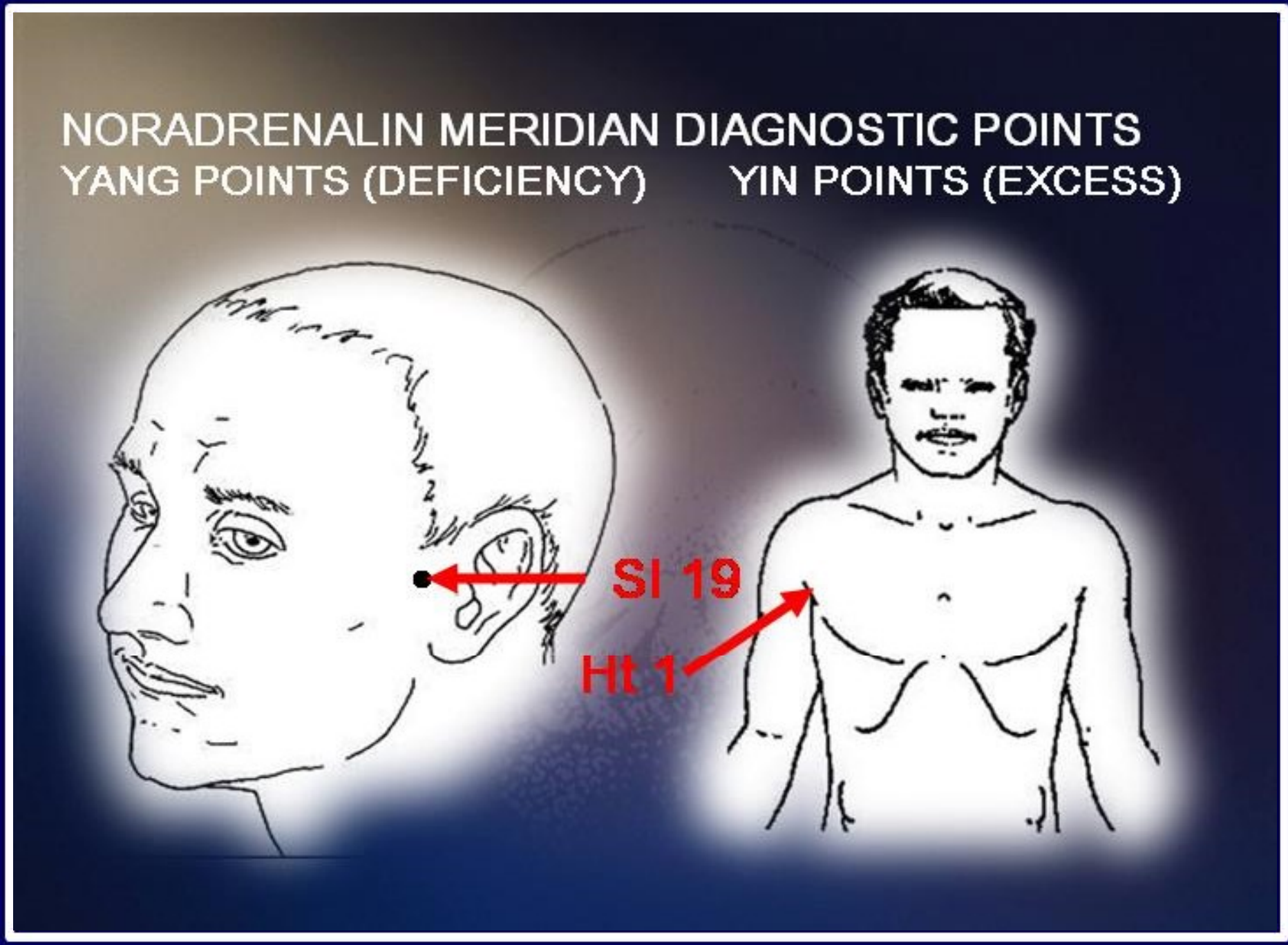
(e.g., those innervating the heart and blood vessels)

and, within the brain, those of the locus ceruleus, a nucleus activated in the process of **focusing attention.**

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

SYMPTOMS

DEFICIENCY	EXCESS
Depression, Apathy (Sloth)	Anxiety, tremor
Lack of "get up and go"	↑ Superoxide production
↓ Superoxide production	Aggressive, violent, and impulsive behaviours
Memory impairment	Irritability (nothing right)
Dementia, Delusions	Hypertension
Delirium	Constipation
Hypotension	Underweight
Short sighted (Myopia)	
Bronchoconstriction-Asthma	Palpitations and Tachycardia
Small intestine problems – food allergy / intolerance	Heart Arrhythmias


NORADRENALIN MERIDIAN DIAGNOSTIC POINTS
YANG POINTS (DEFICIENCY)
YIN POINTS (EXCESS)
SI 19
Ht 1

Exercises to stimulate Noradrenalin – Aerobics class – build heart rate up.

Exercises to inhibit Noradrenalin

Sprinting anaerobically to burn up noradrenalin.

TYRAMINE

Tyramine is an indirect acting catcholaminergic amine found in Bananas and Avocados, Barley grass, Mandarin, Tangerine, Orange, Lemon, Grapefruit, Tomato, Pea, Plum, Aubergine, Cacao, Potato Cheese, Sour cream, Pizzas, Chocolate.

Pickled Herrings, Caviar, Liver, *Salamis,* Broad Beans pods.

Fermented dairy products such as Yoghurt, Sauerkraut

Yeast extracts **including Beer and Wine, Bovril, Oxo, Marmite, MSG and all *fermented Soya Bean products.***

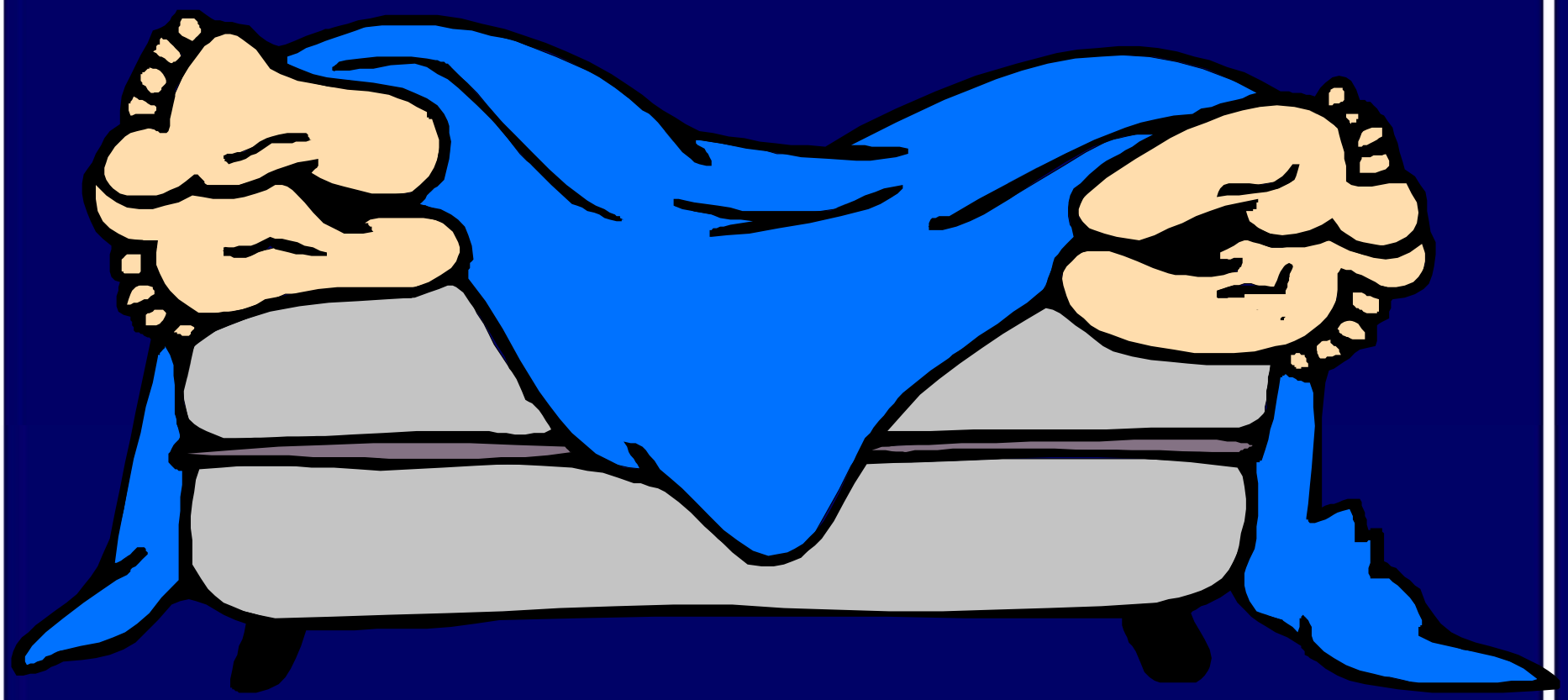
Normally tyramine is completely inactivated by MAO when taken in the diet. Thus inhibition of MAO enzymes will lead to excess sympathetic activity. When these foods are eaten in the evening they often cause disrupted sleep and nightmares if high dopamine.

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

We know these foods because they are not permitted to be ingested when patients are taking monoamine oxidase inhibitor drugs such as

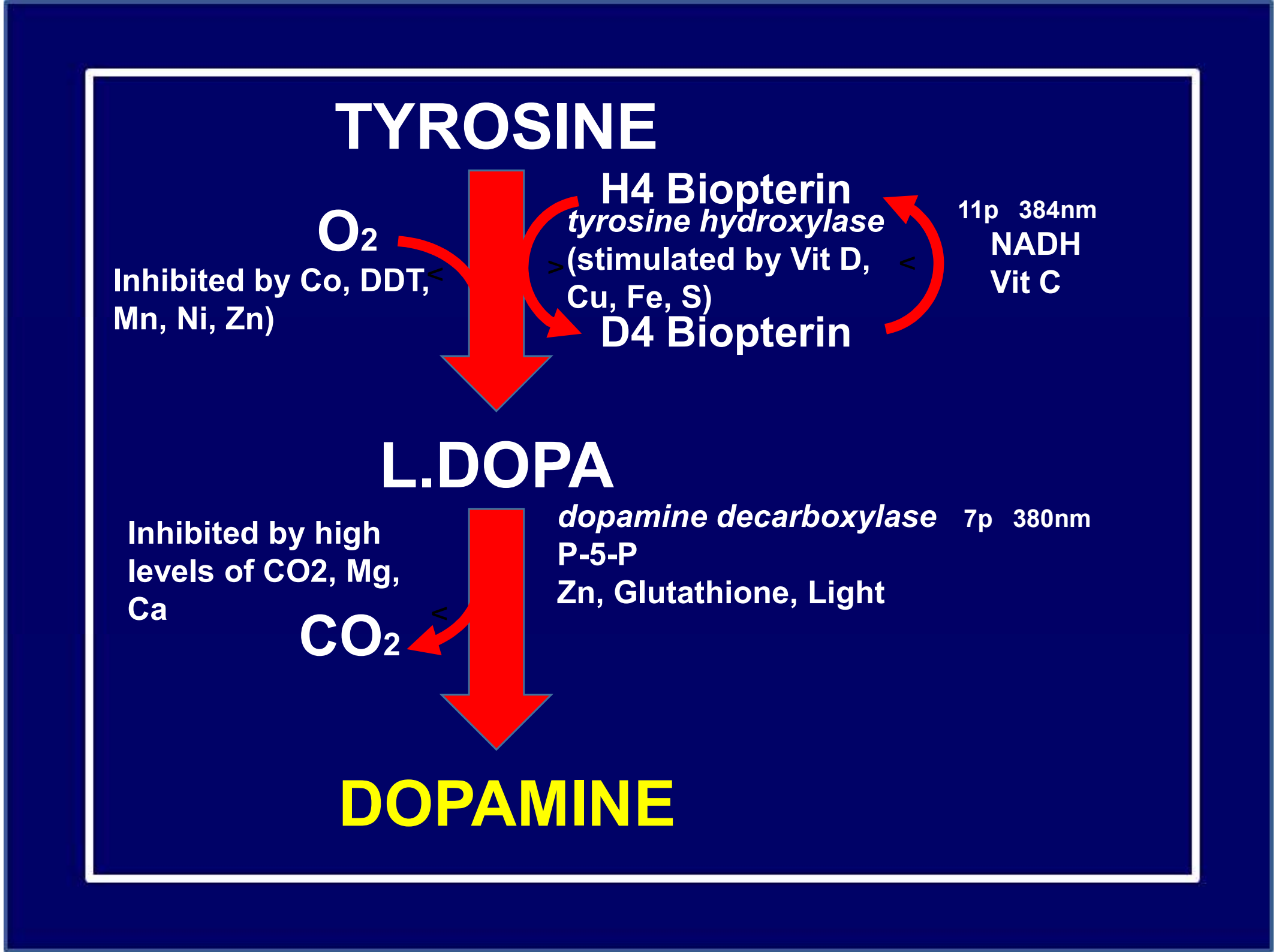
“Marplan”,
“Nardil”,
“Parnate”.

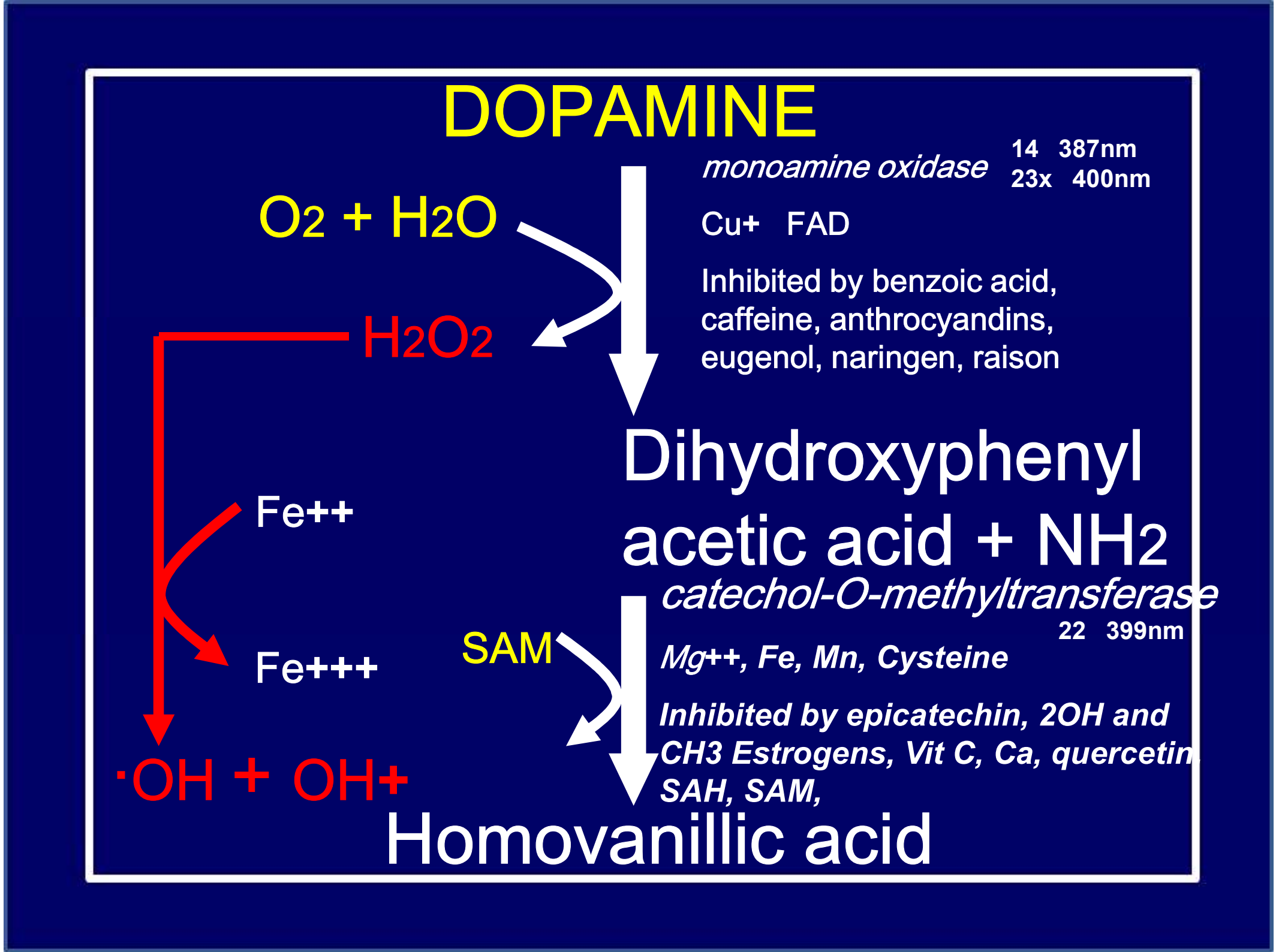
SLEEP DISTURBANCES



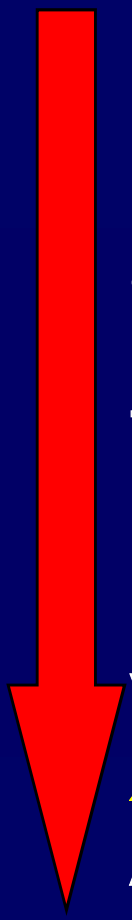
1. Difficulty in going to sleep. Check for high Noradrenalin and Tyramine excess.
2. Nightmares. Check for high Dopamine and Tyramine.
3. Awakes in the middle of the night. Usually a liver problem. Check for high Acetylcholine and detoxification defects.
4. General sleep disturbances maybe due to low serotonin leading also to low melatonin. Check especially for magnesium.

Dopamine


TYROSINE
H4 Biopterin
tyrosine hydroxylase
(stimulated by Vit D, Cu, Fe, S)
D4 Biopterin
O2
Inhibited by Co, DDT, Mn, Ni, Zn)
11p 384nm
NADH
Vit C
L.DOPA
dopamine decarboxylase
P-5-P
Zn, Glutathione, Light
7p 380nm
Inhibited by high levels of CO2, Mg, Ca
CO2
DOPAMINE


DOPAMINE
monoamine oxidase
14 387nm
23x 400nm
O2 + H2O
Cu+ FAD
Inhibited by benzoic acid, caffeine, anthrocyandins, eugenol, naringen, raison
H2O2
Dihydroxyphenyl acetic acid + NH2
Fe++
catechol-O-methyltransferase
22 399nm
SAM
Fe+++
Mg++, Fe, Mn, Cysteine
Inhibited by epicatechin, 2OH and CH3 Estrogens, Vit C, Ca, quercetin SAH, SAM,
·OH + OH+
Homovanillic acid

Homovanillic acid



Glutathione (Cysteine, Glycine, Glutamic acid) NAC, Zn++, P5P, Sel

a-Lipoic or

Sulfation (PAPs) S, MSM

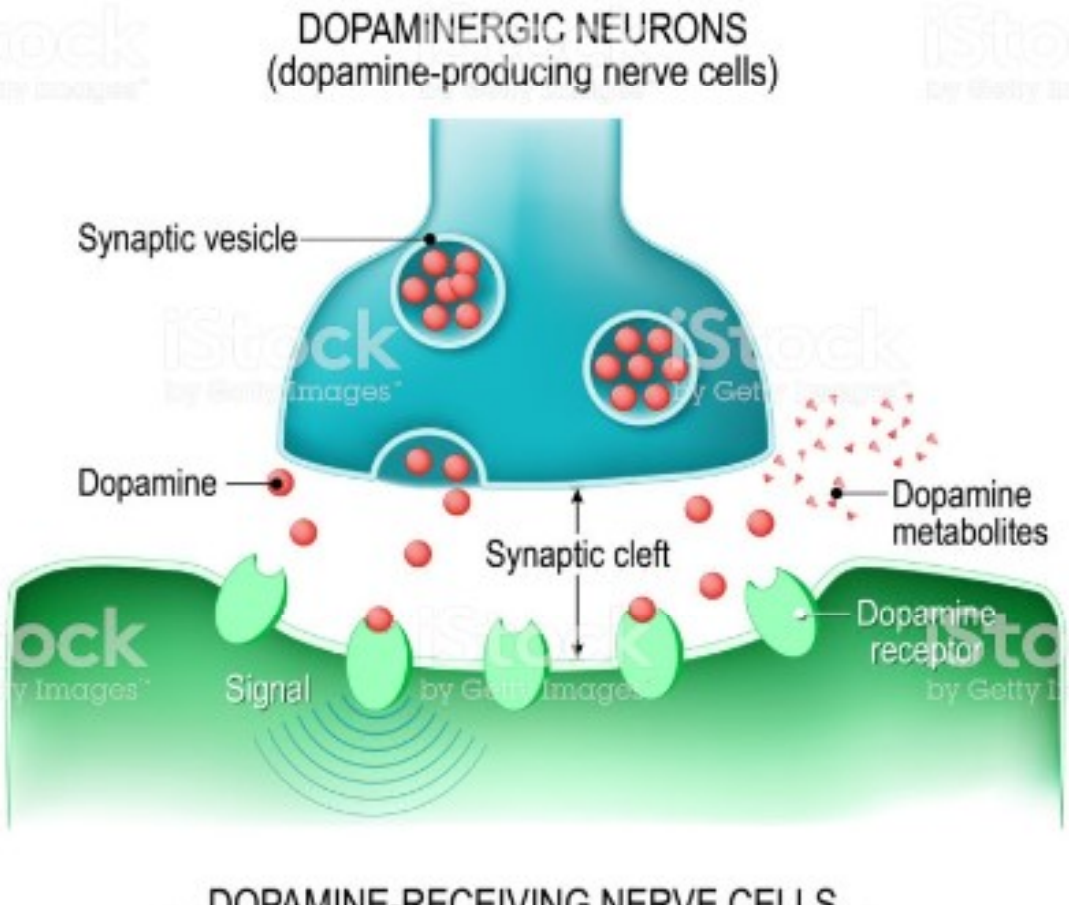
Taurine or

Glucuronidation (UDP Gucuronic acid) Glucuronate, Vit C, or

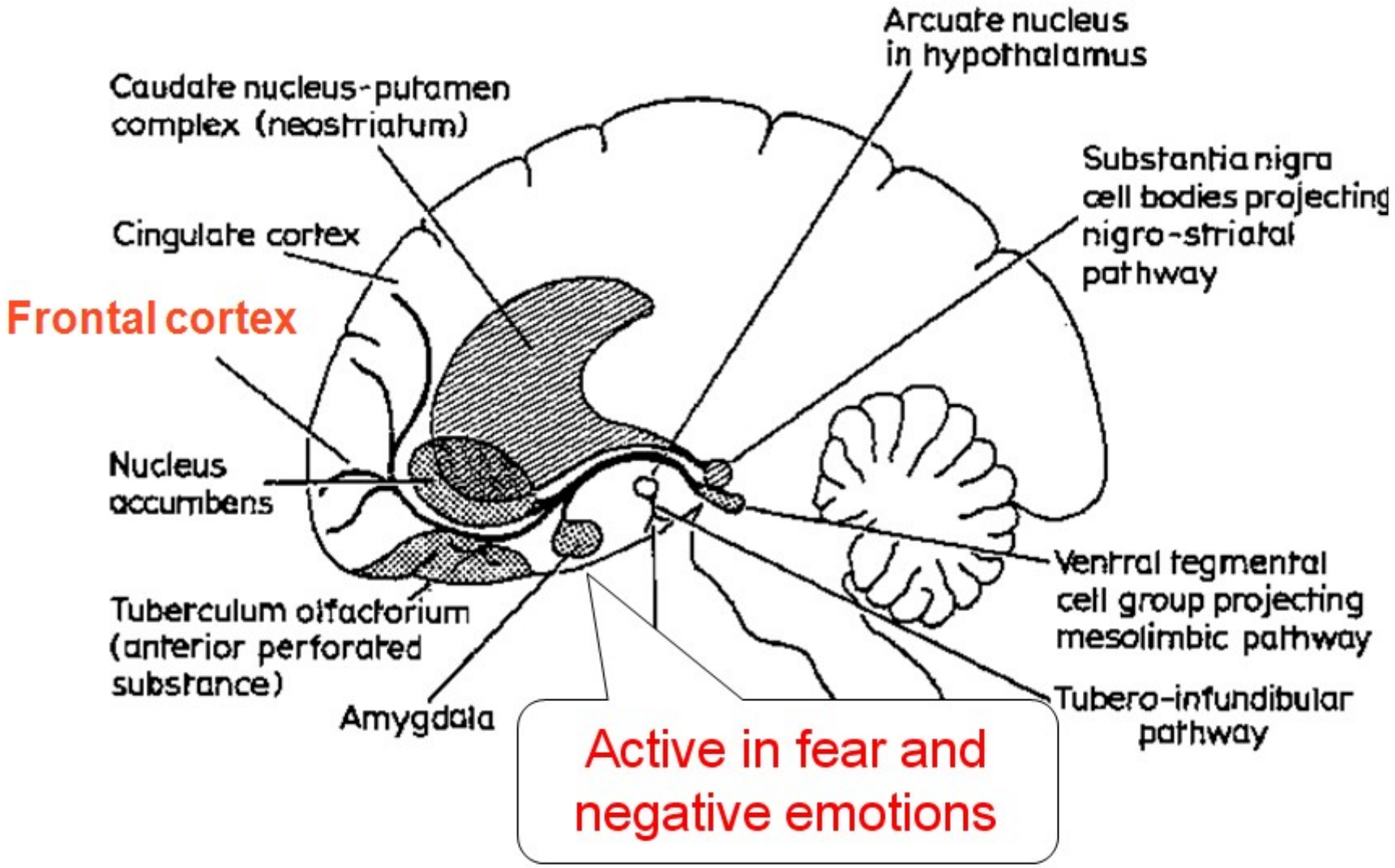
Acetylation (Acetyl CoA) B5, Acetyl CoA

Conjugates excreted through the bile or urine

Dopamine


DOPAMINERGIC NEURONS
(dopamine-producing nerve cells)
Synaptic vesicle
Dopamine
Synaptic cleft
Dopamine metabolites
Dopamine receptor
Signal
DOPAMINE-RECEIVING NERVE CELLS

Dopamine circuits



Dopamine is a neurotransmitter at

1. some sympathetic ganglion.
2. some exocrine glands.
3. the gastrointestinal tract.
4. mesenteric and renal arteries causing vasodilation.
5. carotid body controlling respiratory reflexes. Hypoxia decreases dopamine release in the carotid body and reflexly stimulates respiration.

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

6. the dopaminergic nigro-neostriatal (extrapyramidal) pathway.

7. dopaminergic midbrain mesolimbic forebrain system associated with cognitive, reward and emotional behaviour.

8. dopaminergic tubero-infundibular system associated with neuronal control of the hypothalamic-pituitary endocrines.

9. retina and is associated with photophobia and illumination.

Dopamine Receptors

Mainly are located in the CNS but many peripheral tissues such as the gut, blood vessels and the heart respond to exogenously applied dopamine indicating their sensitivity.

Receptors are sub-typed as

D1 located in post synaptic structures.

D2 located pre and post synaptically.

D3 located mainly in the mesolimbic pathways.

Some dopaminergic (i.e., dopamine-releasing) neurons run from the substantia nigra to the corpus striatum; their loss gives rise to the clinical manifestations of Parkinson's Disease; others, involved in the rewarding effects of drugs and natural stimuli, run from the mesencephalon to the nucleus accumbens.

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

Dopaminergic neurons involved in the actions of most antipsychotic drugs (which antagonize the effects of dopamine on its receptors) run from the brain stem to limbic cortical structures in the frontal region, while the dopamine released from hypothalamic cells travels via a private blood supply

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

the pituitary portal vascular system, to the anterior pituitary gland, where it tonically suppresses release of the hormone prolactin.

(Drugs that interfere with the release or actions of this dopamine can cause lactation as a side-effect, even in men.)

Dopamine enhances

Sex drive

Mood

Alertness

Movement

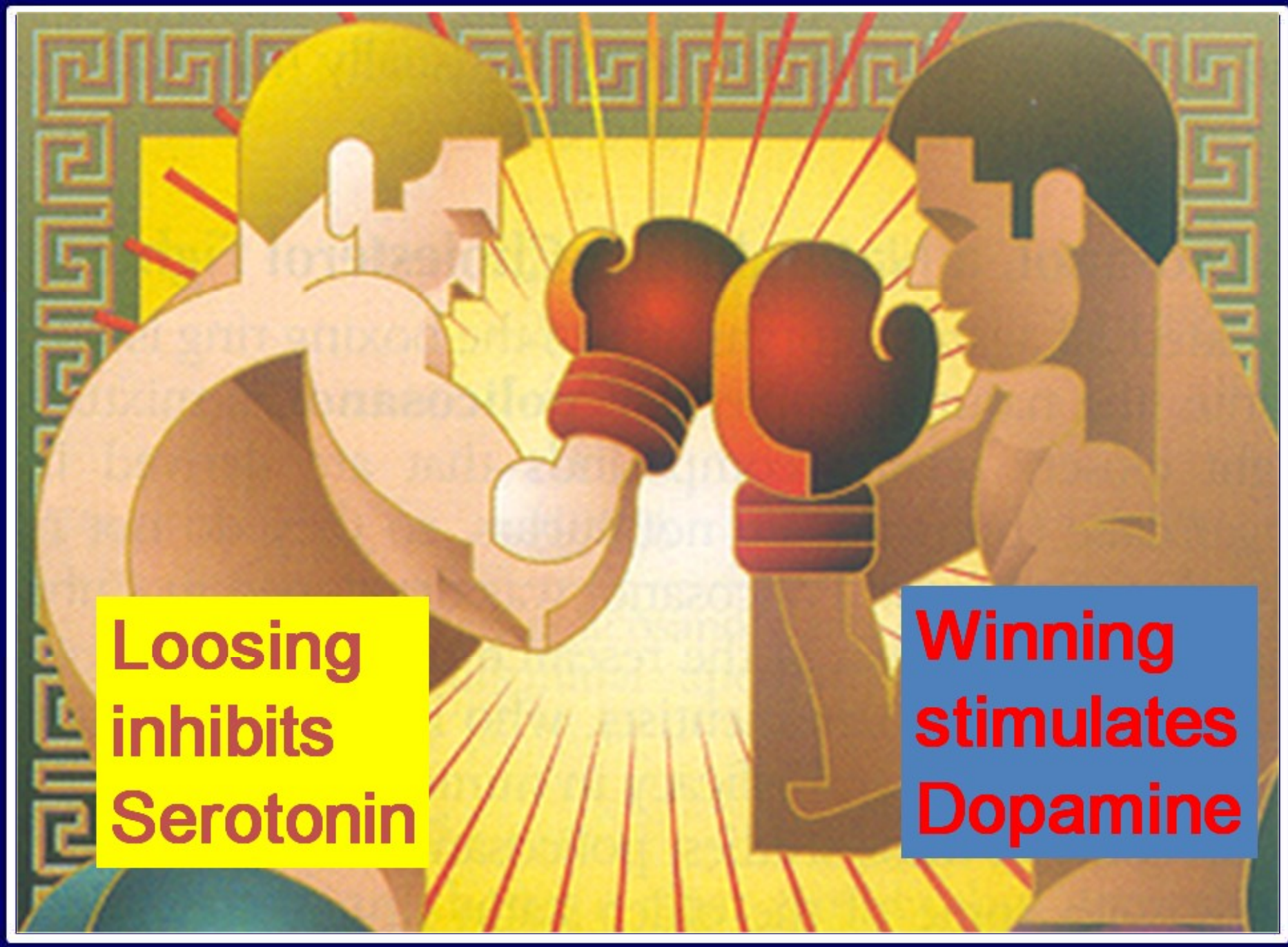
Berridge, K. C; Robinson, T. E; Aldridge, J. W (2009). "Dissecting components of reward: 'liking', 'wanting', and learning". *Current Opinion in Pharmacology*. 9 (1): 65–73.

Dopamine facilitates critical brain functions when present in normal amounts. It is associated with the feeling of pleasure and pain, and helps to mediate the reinforcing effects of natural rewards such as food, water, and sex. It is associated with emotional responses and subconscious skeletal muscle movements.

Schultz W (July 2015). "Neuronal Reward and Decision Signals: From Theories to Data". *Physiological Reviews*. 95 (3): 853–951.

Dopamine is used to communicate between the **hypothalamus and the pituitary gland,** in the control of movement, and in the communication between the **limbic system and frontal cortex.**

Ben-Jonathan N, Hnasko R (December 2001). "Dopamine as a prolactin (PRL) inhibitor". *Endocrine Reviews*. 22(6): 724–63.


Loosing
inhibits
Serotonin
Winning
stimulates
Dopamine

SYMPTOMS

Bipolar manic depression

DEFICIENCY	EXCESS
Grief and Regret	*Craving and Desire*
↓TH2 production	↑TH2 production
Indecision	Anxiety
Poor concentration	Aggression
Irrational behaviour	Confusion
A world without pleasure.	Nightmares
Clumsiness, Photophobia	Psychoses
Dendritic growth inhibition	Schizophrenia
Depression / Manic depression	
Loss of smell, Tremor	
Rigidity , Pains	

Famous Manic Depressives

Winston Churchill

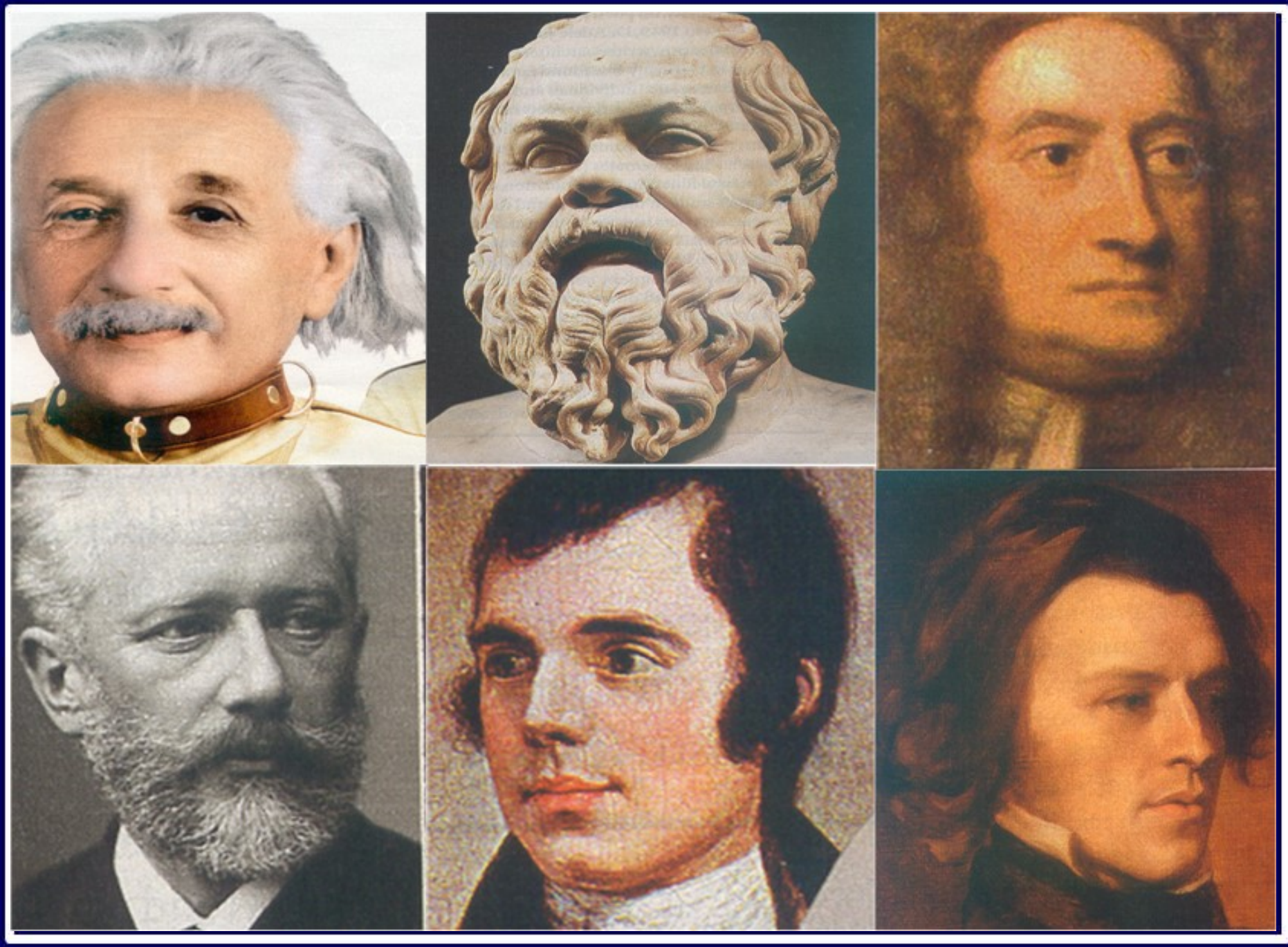
Spike Milligan

Florence Nightingale

Vincent Van Gough

Lord Byron

Edgar Allen Poe



Albert Einstein

Socrates

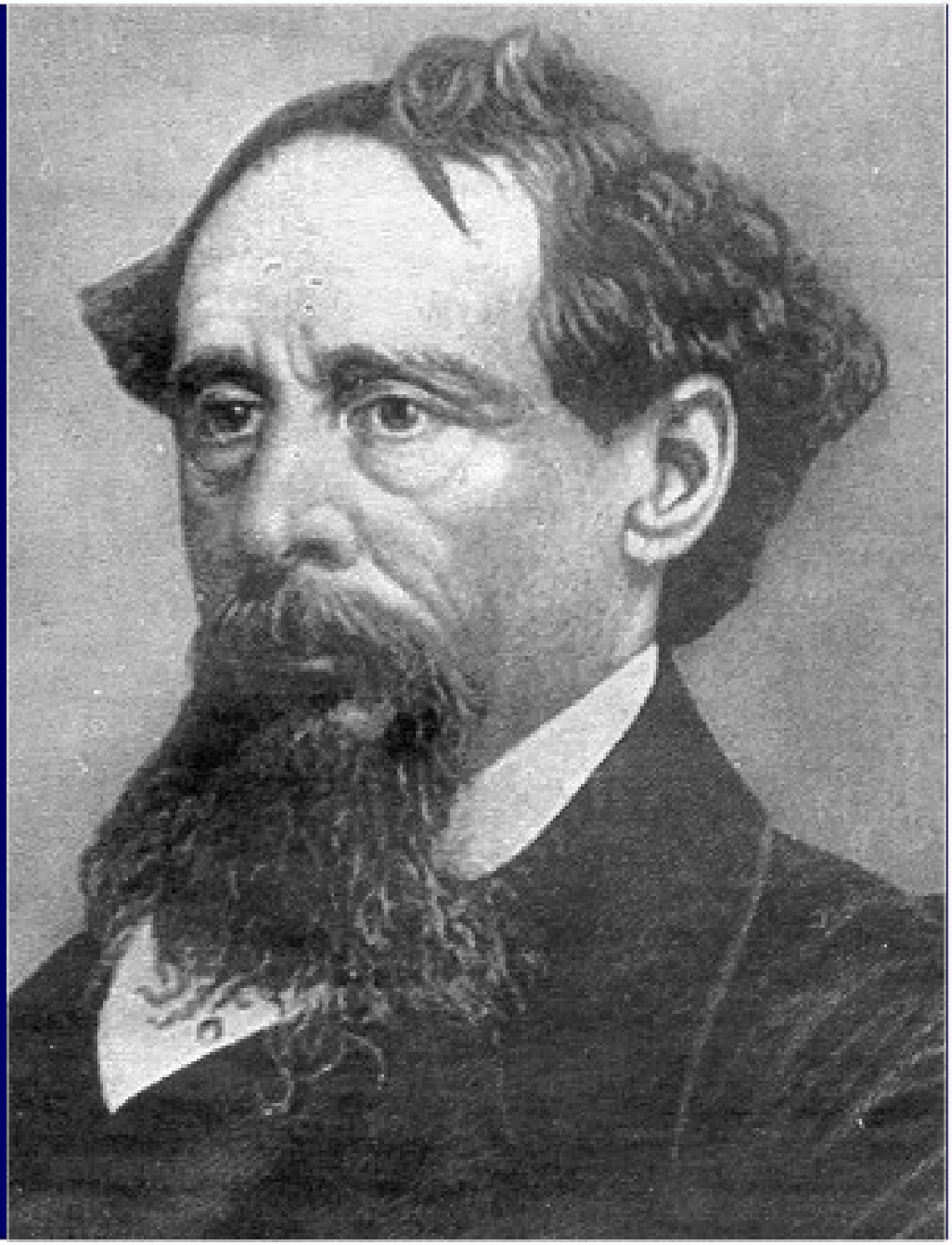
Isaac Newton

Peter Tchaikovsky

Robert Burns

Lord Tennyson

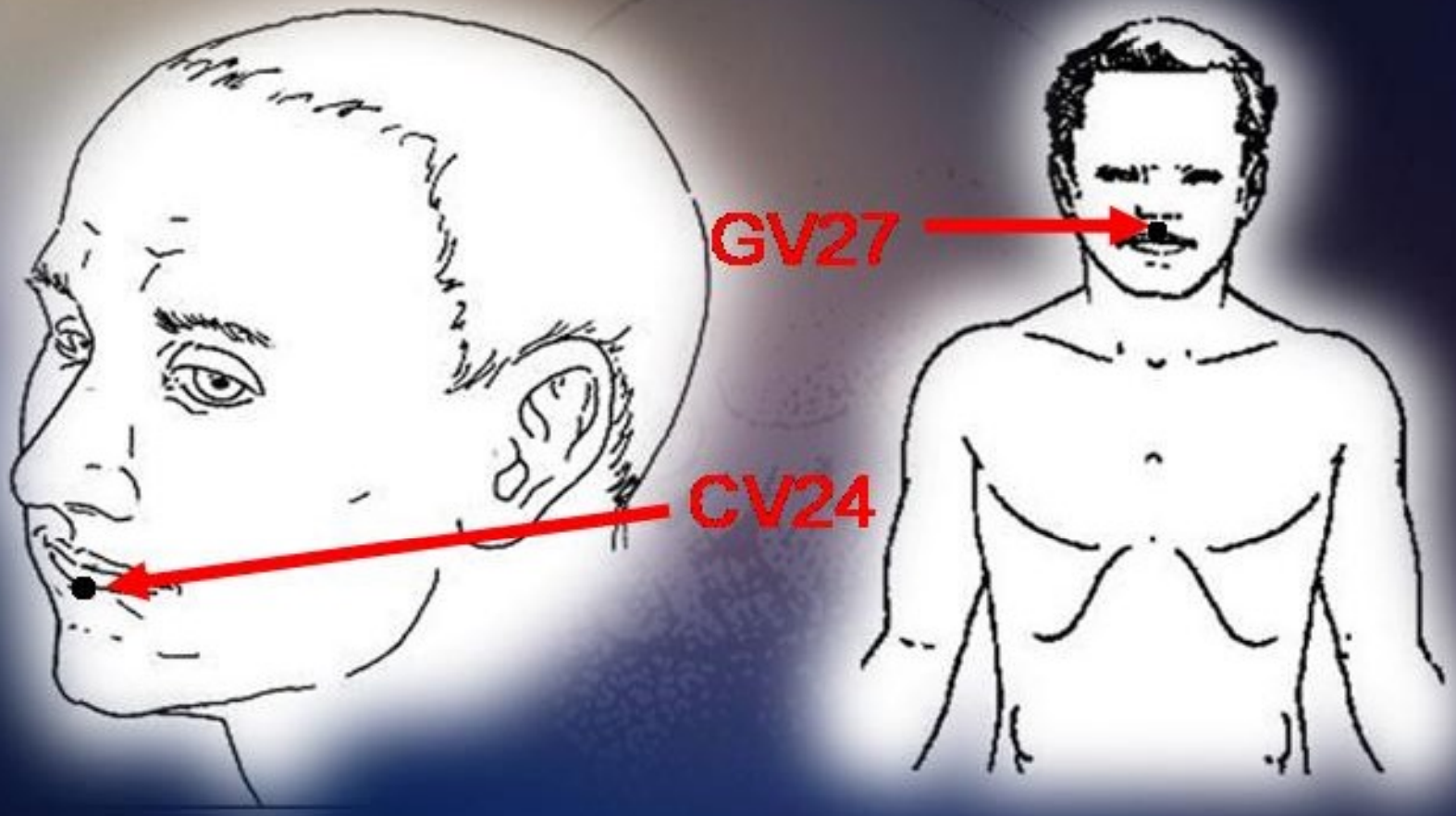
Charles Dickens, manic energy fed his creativity but also led to insomnia and depression.



DOPAMINE MERIDIAN DIAGNOSTIC POINTS

YANG POINTS (DEFICIENCY)

YIN POINTS (EXCESS)



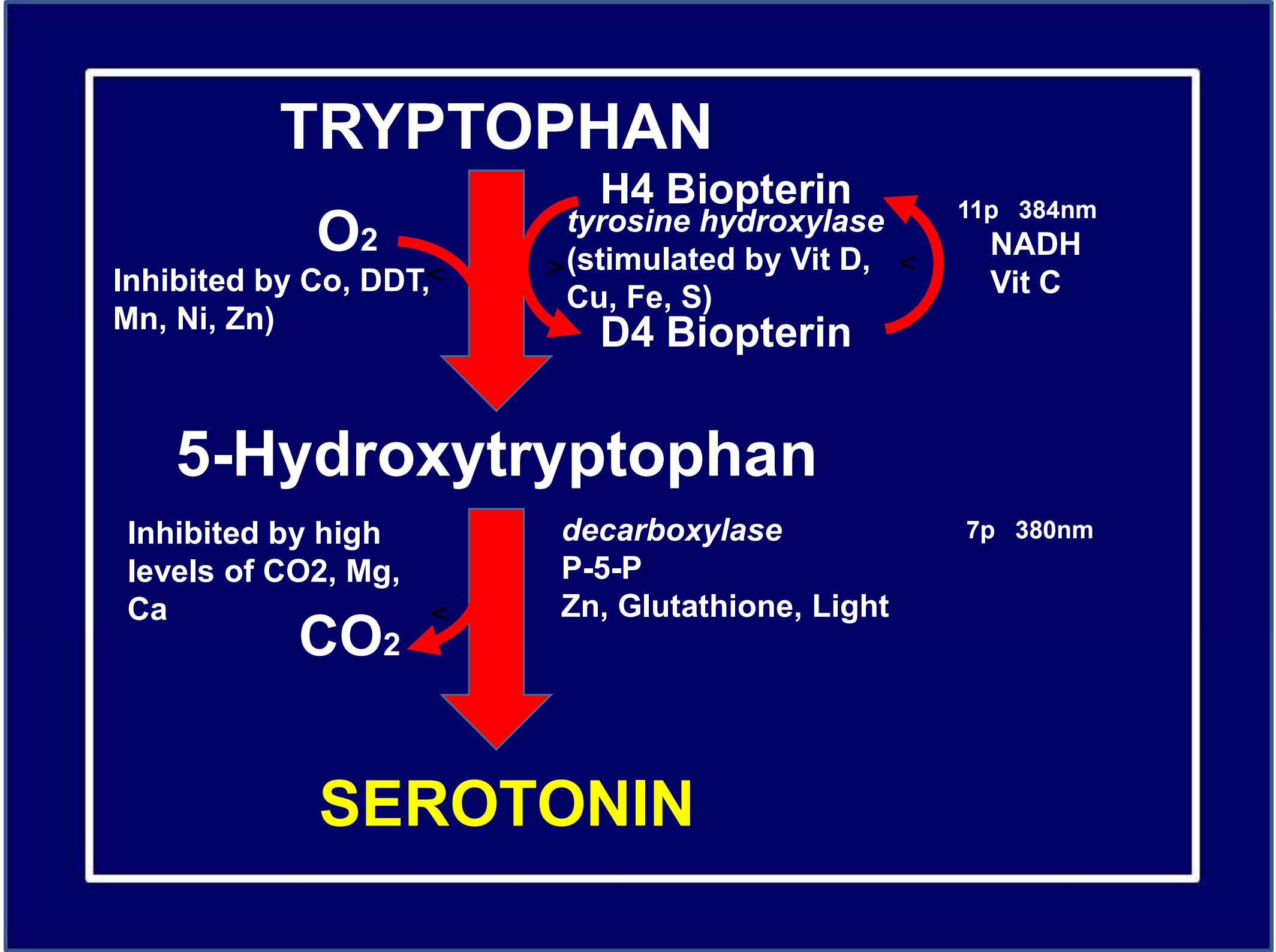
Exercises to stimulate Dopamine

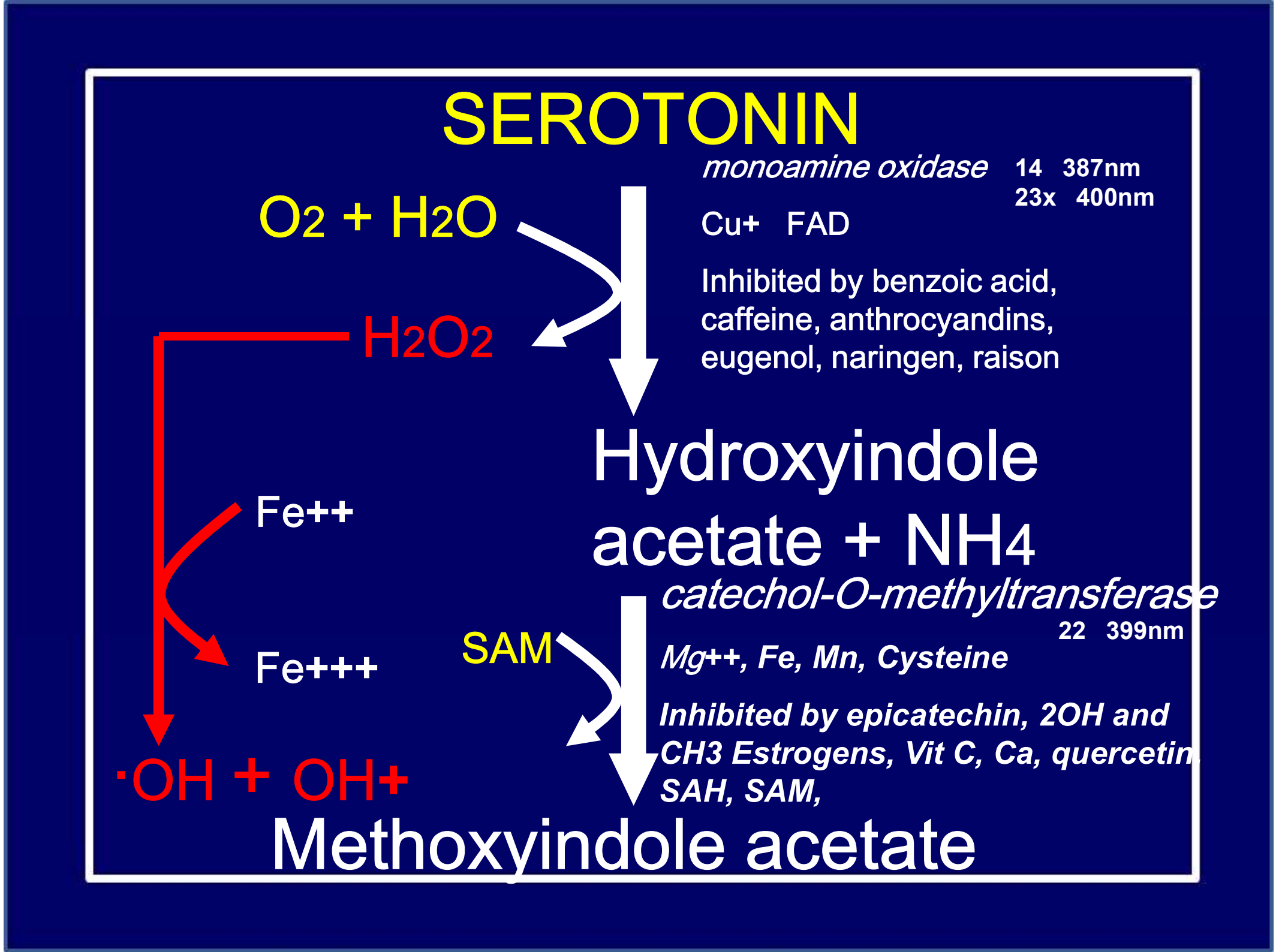
Running - aerobically

Exercises to inhibit Dopamine

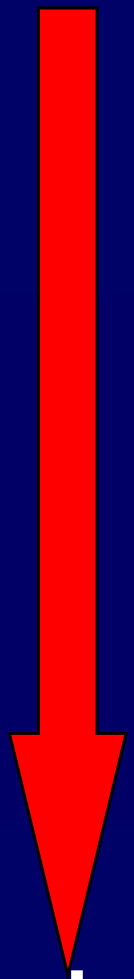
Sailing or any sport that they can achieve in

Serotonin


TRYPTOPHAN
H4 Biopterin
tyrosine hydroxylase
(stimulated by Vit D, Cu, Fe, S)
D4 Biopterin
O2
Inhibited by Co, DDT, Mn, Ni, Zn)
11p 384nm
NADH
Vit C
5-Hydroxytryptophan
Inhibited by high levels of CO2, Mg, Ca
CO2
decarboxylase
P-5-P
Zn, Glutathione, Light
7p 380nm
SEROTONIN


SEROTONIN
monoamine oxidase
14 387nm
23x 400nm
O2 + H2O
Cu+ FAD
Inhibited by benzoic acid, caffeine, anthrocyandins, eugenol, naringen, raison
H2O2
Hydroxyindole acetate + NH4
Fe++
catechol-O-methyltransferase
22 399nm
SAM
Fe+++
Mg++, Fe, Mn, Cysteine
Inhibited by epicatechin, 2OH and CH3 Estrogens, Vit C, Ca, quercetin SAH, SAM,
·OH + OH+
Methoxyindole acetate

Methoxyindole acetate



Glutathione (Cysteine, Glycine, Glutamic acid) NAC, Zn++, P5P, Sel a-Lipoic or

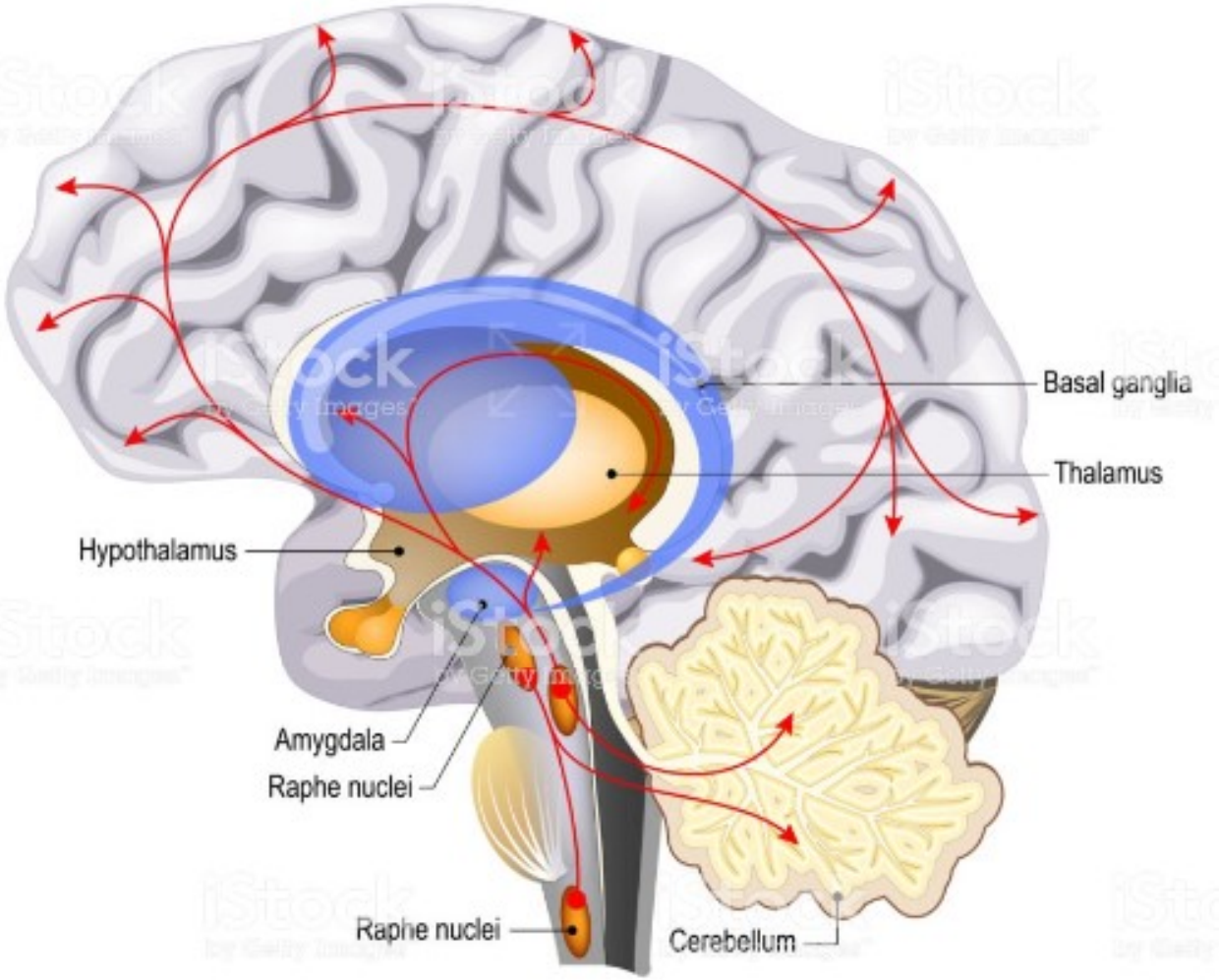
Sulfation (PAPs) S, MSM Taurine or

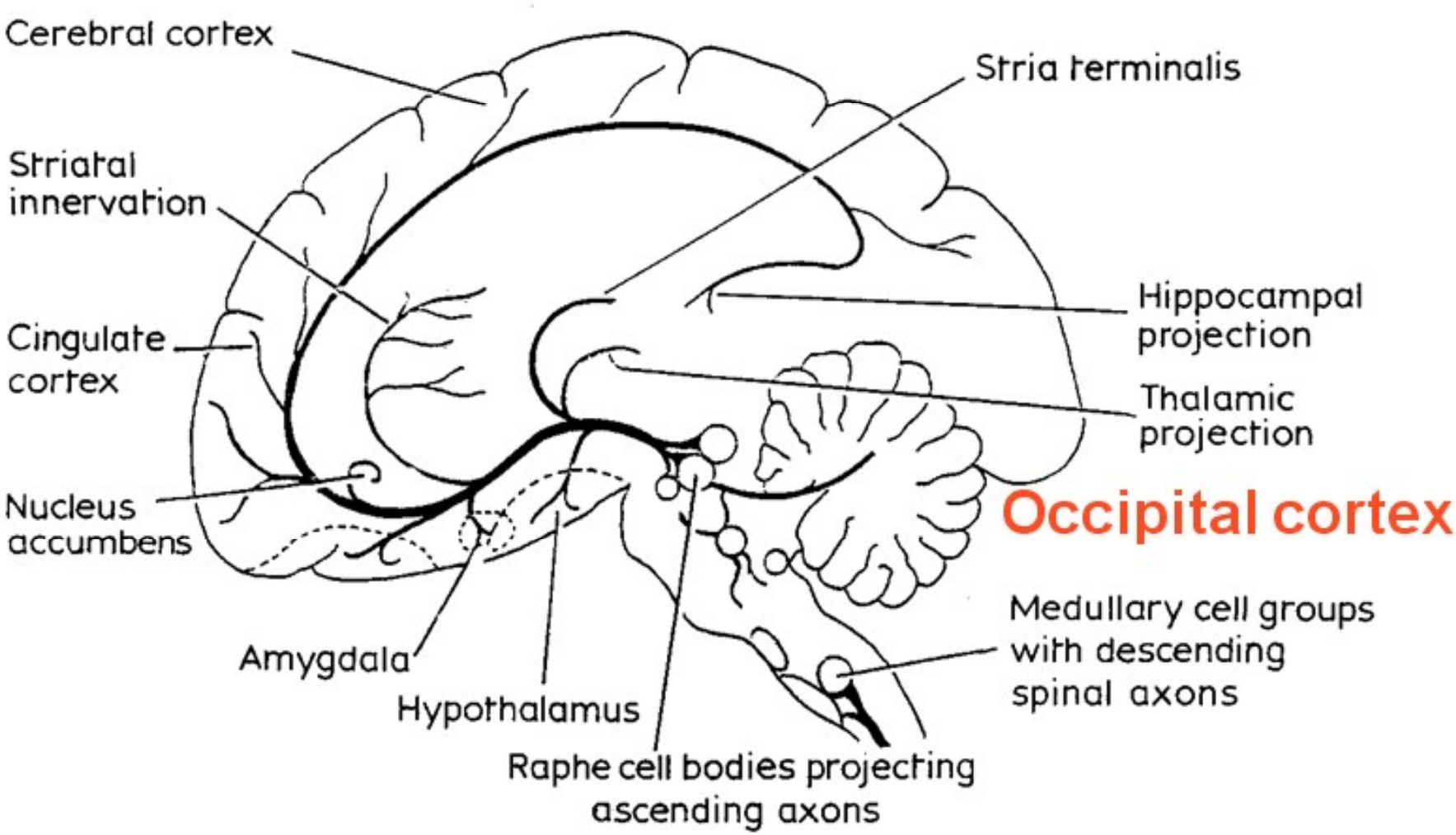
Glucuronidation (UDP Gucuronic acid) Glucuronate, Vit C, or

Acetylation (Acetyl CoA) B5, Acetyl CoA

Conjugates excreted through the bile or urine

Serotonin pathway




Cerebral cortex
Striatal innervation
Cingulate cortex
Nucleus accumbens
Amygdala
Hypothalamus
Raphe cell bodies projecting ascending axons
Stria terminalis
Hippocampal projection
Thalamic projection
Occipital cortex
Medullary cell groups with descending spinal axons

Serotonin is a neurotransmitter at

1. the midline raphe nuclei of the rostral pons
2. basal ganglion
3. hypothalamus
4. thalamus
5. hippocampus
6. limbic forebrain
7. areas of the cortex
8. brain stem to the medulla and spinal cord

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

The cell bodies, of serotoninergic neurons reside in the brain stem; their axons can descend in the spinal cord (where they "gate" incoming sensory inputs and also decrease sympathetic nervous outflow, thus lowering blood pressure) or ascend to other parts of the brain.

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

Brains of women produce only about two-thirds as much serotonin as those of men; this may explain their greater vulnerability to serotonin-related diseases like depression and obesity.

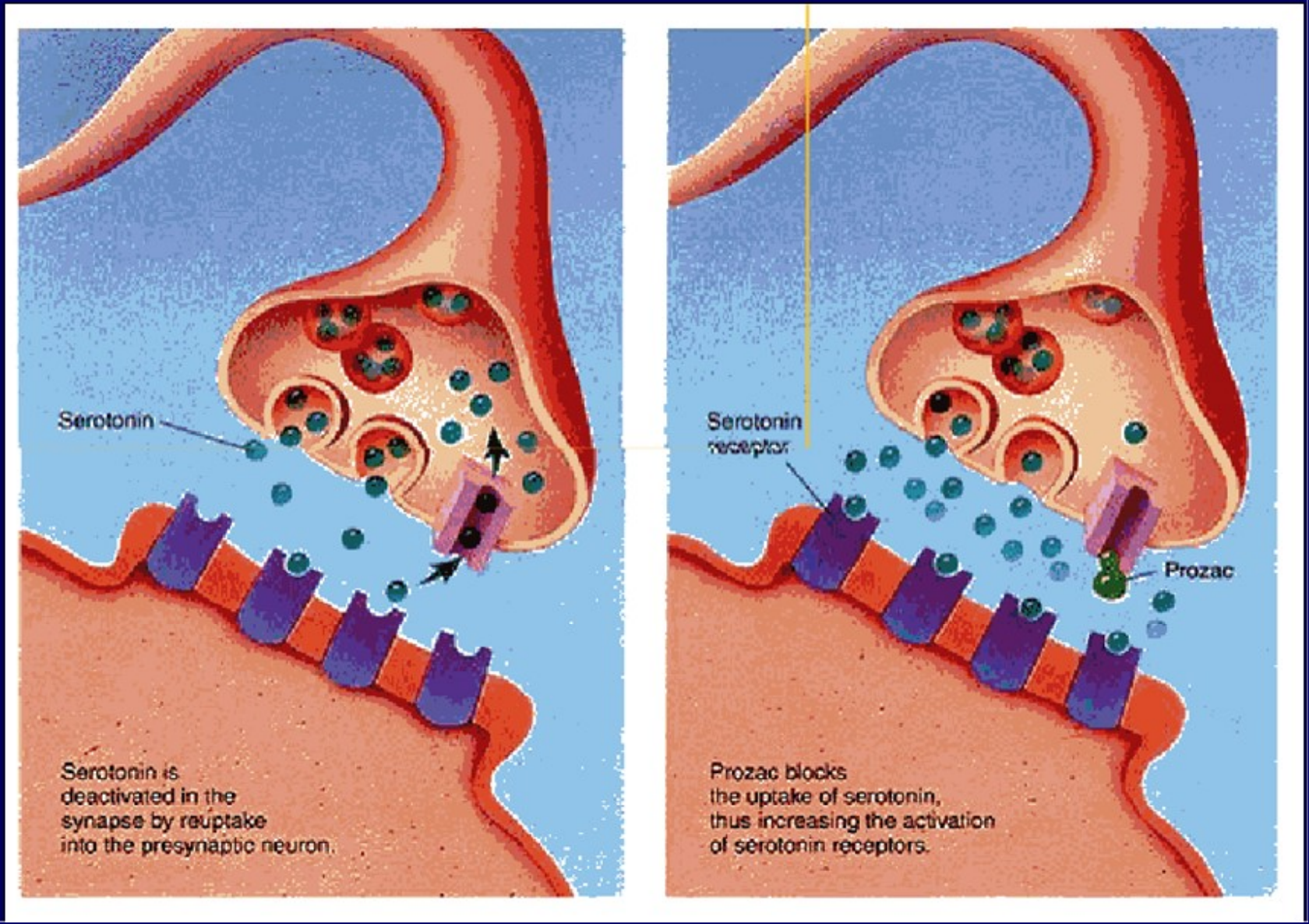
Within the pineal gland serotonin is also the precursor for the sleep - inducing hormone **melatonin.**

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

Serotoninergic nerve terminals are found in virtually all regions, enabling this transmitter to modulate mood; sleep; total food intake and macronutrient (carbohydrate vs. protein) selection; aggressive behaviours; and PAIN sensitivity.

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

Blockage of reuptake by Prozac

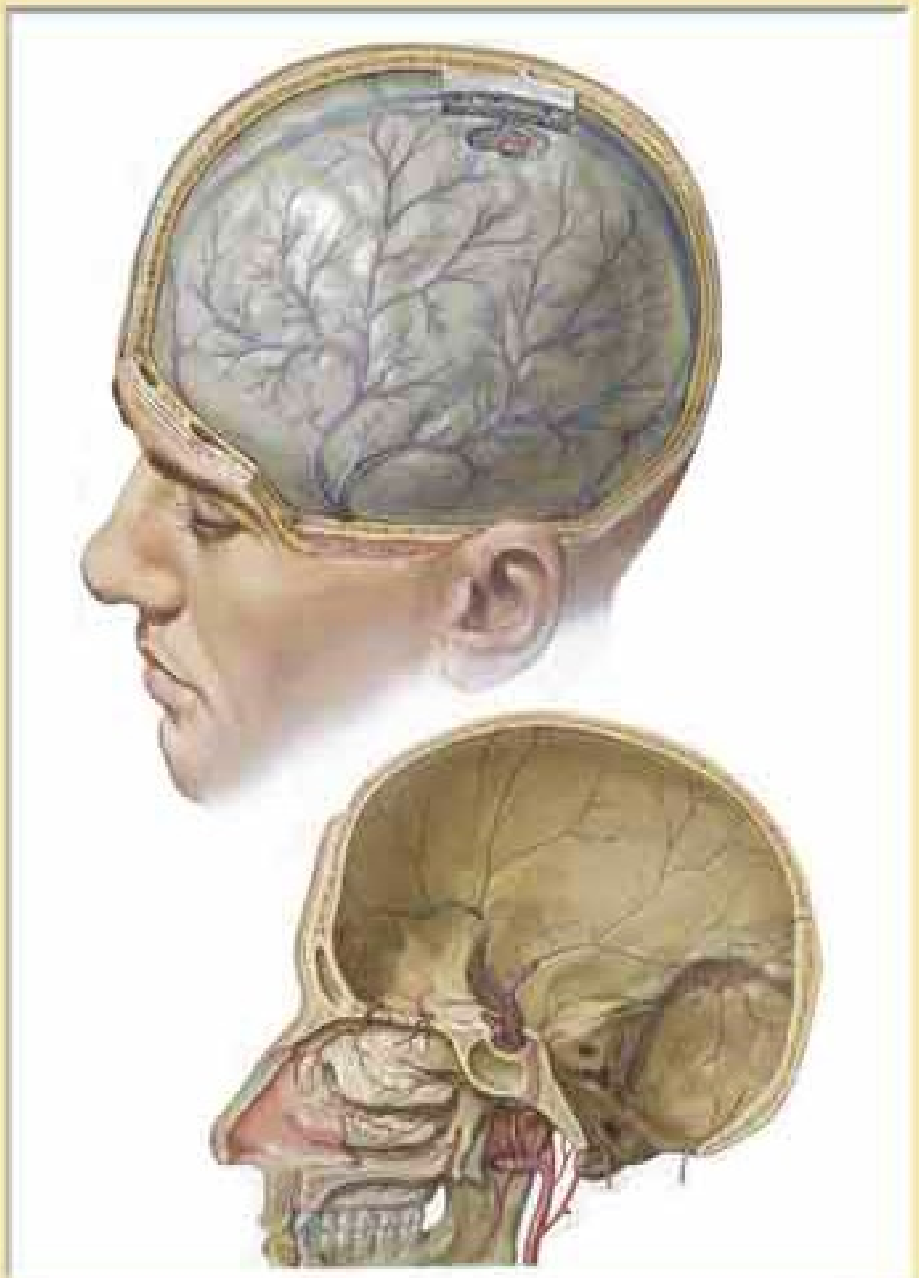


Experiments using Prozac showed initially an increase in transit time in the gut motility. As the dose increased the motility slowed until it stopped. This indicated a loss of receptor activity due to over saturation. This may occur in the brain and it may predispose to an acute depressive crisis leading in severe cases to suicide.

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

Migraines and Serotonin

Serotonin is systemically a vasoconstrictor, but a vasodilator of the mid meningeal artery.



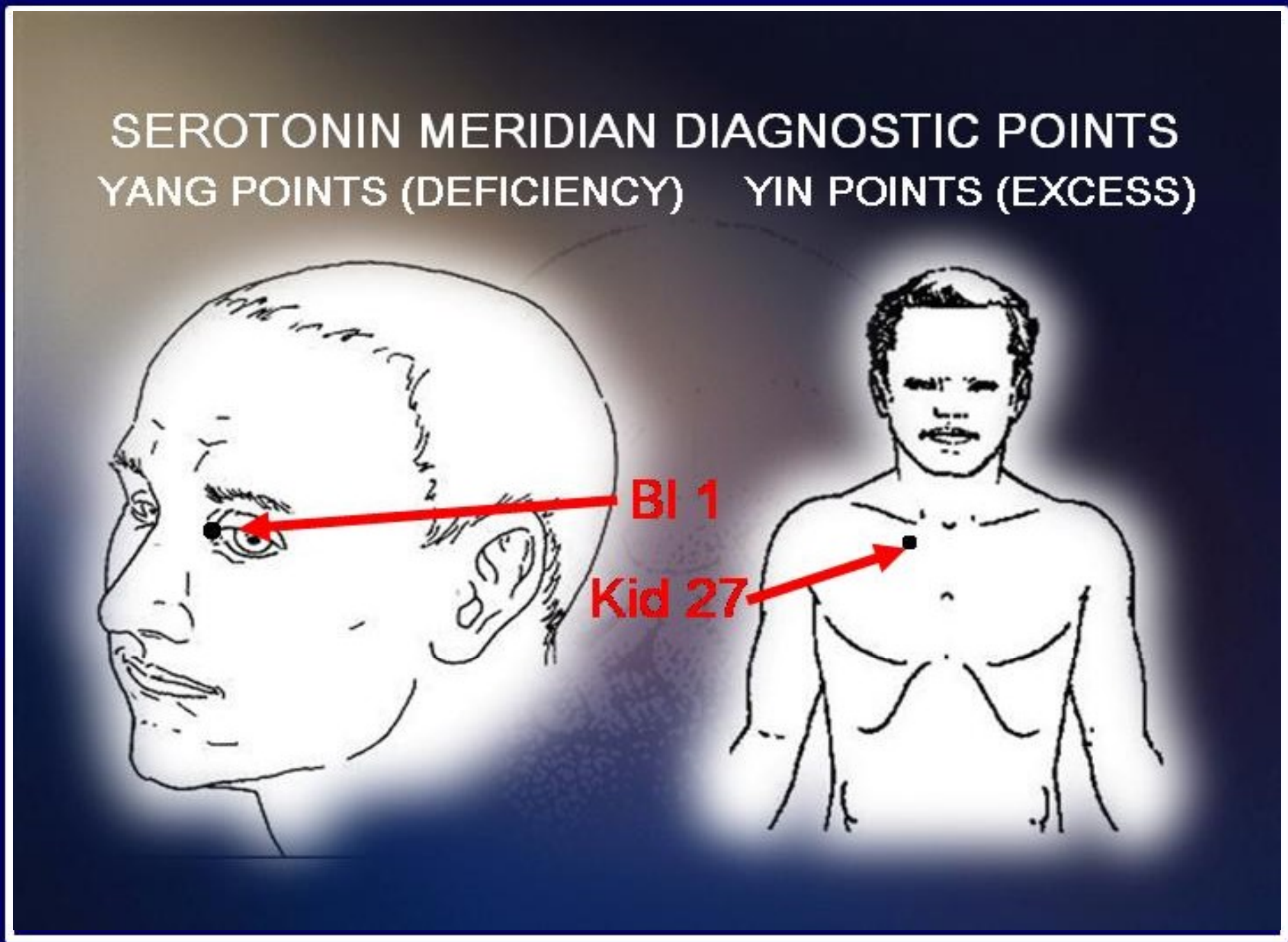
Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

SEROTONERGIC RECEPTORS

5-HT release either from nerves or from platelets causes vasoconstriction of all large blood vessels.

Currently there are fifteen different receptor subtypes.

DEFICIENCY	EXCESS
Shame and Humiliation	*Anxiety and Fear*
↓ B cell production	↑ B cell production
Depression (the blues)	Migraine
Suicide, Sleep disorders	Depression
Compulsive disorders	Pains
Obsessive behaviour	Anorexia
such as Anorexia nervosa, Bulimia, weight gain	Masked aggression
Decreased libido	Obsessive compulsion
Impulsive aggression	Shyness
Alcoholism, Sexual deviance	Lack of self confidence
Explosive rage	Low sex drive
Low blood pressure	Hypertension
Low body temperature	High body temperature
Bladder problems-Toxic metal	Kidney problems-Toxic metal
	Need for more water


SEROTONIN MERIDIAN DIAGNOSTIC POINTS
YANG POINTS (DEFICIENCY)
YIN POINTS (EXCESS)
BI 1
Kid 27

Exercises to stimulate Serotonin

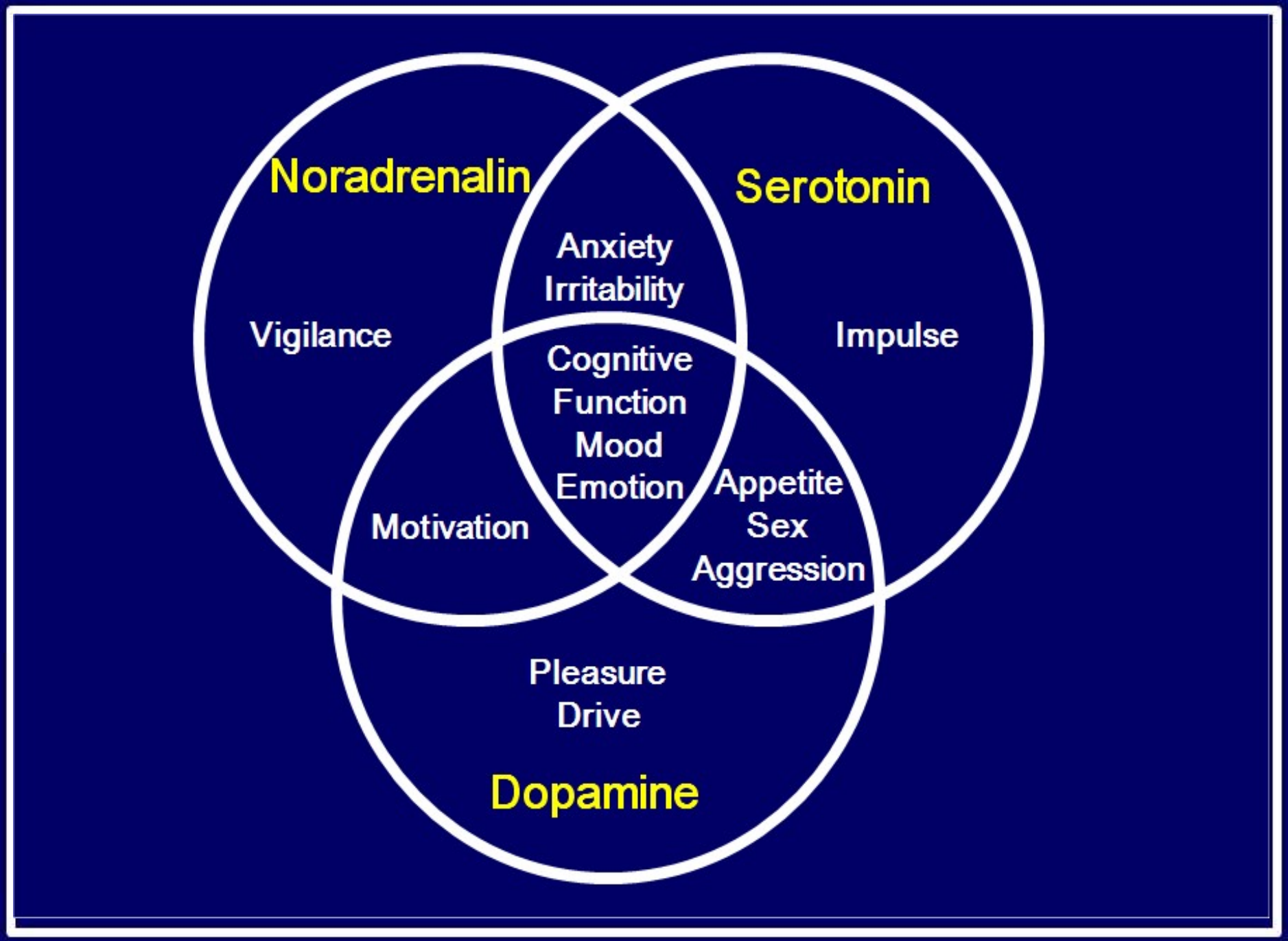
Walking outside in daylight, Gardening

Any activity in a garden such as weeding, pruning, cultivating and harvesting has been shown to increase low levels of serotonin.

Dr Roger Ultrich Texas A&M University
August 2003

Exercises to inhibit Serotonin

Tai Chi (calm and relaxing)



Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

The neurotransmitters serotonin, noradrenaline and dopamine are involved in the control of many of our mental states, sometimes acting on their own and other times acting together. These, and other neurotransmitters, are likely to play a pivotal role in the pathological basis of mental illness and brain disease.

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

Understanding the numerous neurotransmitters, their receptors, their location, and their interactions with one another has been central to the design of medicines for mental illness and has led to the development of successful products for many brain disorders.

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

Depression is a state of low mood and aversion to activity that can affect a person's thoughts, behaviour, feelings and sense of well-being.

Anxiety is a feeling of worry, nervousness, or unease about something with an uncertain cause or outcome.

Manic depression or Bipolar disorder, is a mental disorder characterized by periods of elevated mood and periods of depression.

Psychosis is a severe mental disorder in which thought and emotions are so impaired that contact is lost with external reality.

Schizophrenia is a mental disorder often characterized by abnormal social behaviour and failure to recognize what is real.

Paranoid schizophrenia is the most common subtype of schizophrenia in which the patient has delusions that a person or some individuals are plotting against them or members of their family.

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

Review explores mounting science linking B vitamins and depression

By Adi Menayang

08-Aug-2017

Last updated on 09-Aug-2017 a

Source: Maturitas

Published online ahead of print, **http://dx.doi.org/10.1016/j.maturitas.2016.11.012**

The effects of vitamin B on the immune/cytokine network and theirinvolvement in depression

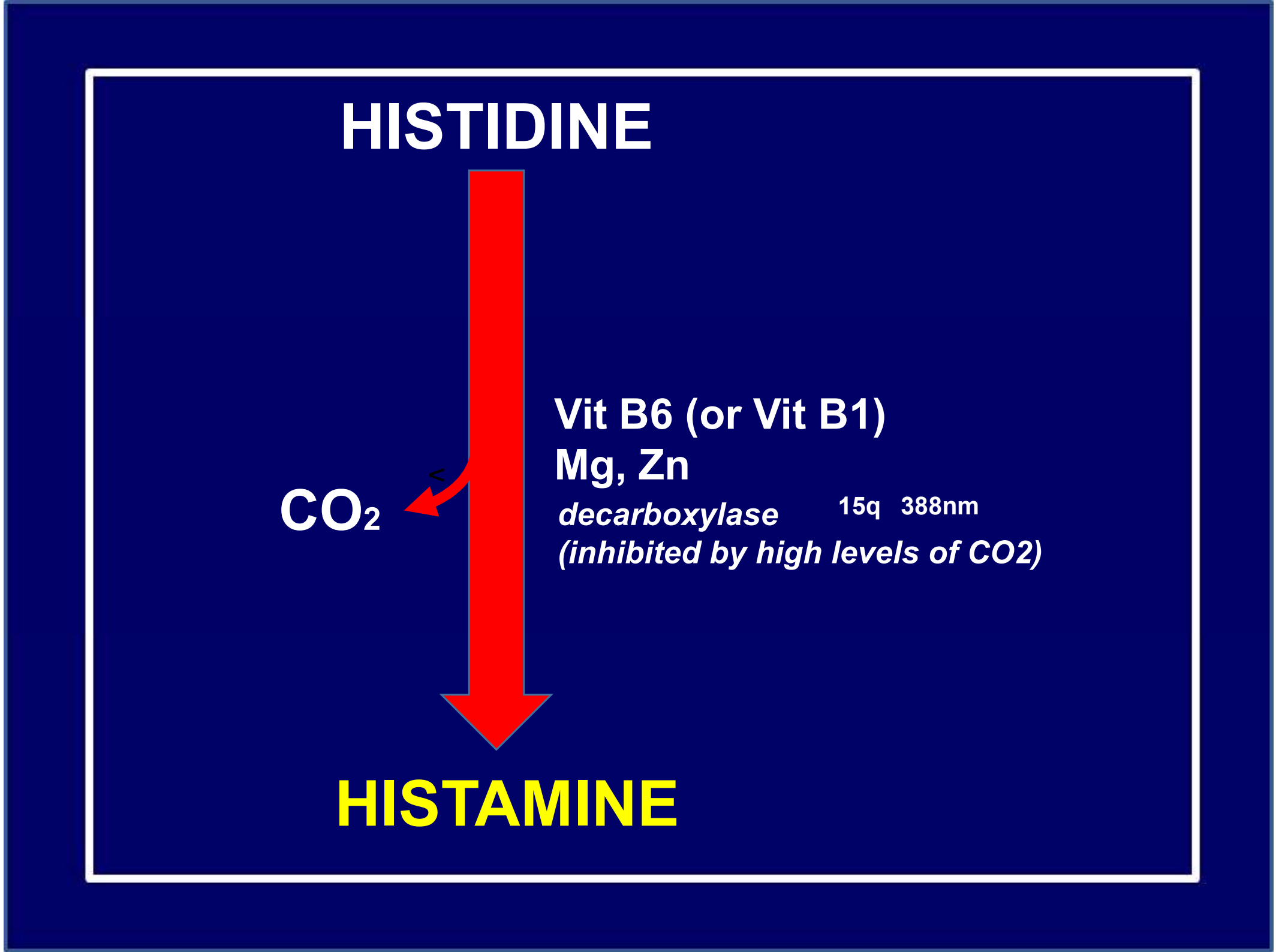
Authors: Kathleen Mikkelsen, et al

Supplementation of B vitamins may improve symptoms of depression, according to researchers from the College of Health and Biomedicine at Victoria University, Australia.

"Vitamin B deficiency (B1, B2, B6, B12) is used by clinicians to recognize and treat psychiatric disorders," they wrote in their review, **published** in the journal *Maturitas. "It is clear that deficiency in B vitamins results in symptoms of depression, thus affecting health and well-being of individuals."*

Histamine

Histamine is most often thought of as a bad guy, associated with irritation.
In fact it is associated with arousal.


HISTIDINE
CO_2
Vit B6 (or Vit B1)
Mg, Zn
decarboxylase
15q 388nm
(inhibited by high levels of CO2)
HISTAMINE

HISTAMINE

methyltransferase 2q 373nm

SAM (Mg++, Zn++, P5P)
Methylcobalamin
Methyltetrahydrofolate

diamine oxidase

O2 7q m
(adenosylcobalamin)

Vit C
Fe++

P5P

2q 373nm
18 393nm
aldehyde oxidase

O2
(adenosylcobalamin)

NAD, FAD

Mol, Fe++

K, Thiols

Methylhistamine

Imidazole acetic acid

monoamine oxidase

O2 14 387nm
(Fe++, 23x 400nm
Adenosylcobalamin)

FMN / FAD
Cu

(systemic histamine)
Natural anti histamines -
Vit E, Zn, Mg,
Bioflavonoids

Methyl imidazole acetic acid

Low stomach acid (hypochlorrhydria) causes the morning nausea and sickness often associated with pregnancy

Histamine activates cAMP.

cAMP stimulates a Protein kinase which phosphorylates carbonic anhydrase.

Carbonic anhydrase forms HCl in the stomach and $NaHCO_3$ in the pancreas.

Low stomach HCl leads to nausea.

Histamine stimulates
Hydrochloric acid
Pepsinogen
Secretin
Nitric Oxide (from iNOS)

So stimulating
Alertness
Sexuality
Motor activity

Histamine is a neurotransmitter at CNS pathways involved in

1. Arousal
2. Nausea and vomiting
3. Control of blood pressure
4. Control of water metabolism

Histamine foods

Bananas, Prickly pear, Stinging nettle, Cabbage, Milk thistle, Shepherds purse, Celendine, Melon, Sunflower, Strawberries, Sauerkraut, Salami, Bacon, Bass, Beer, Chicken, Cocoa, Chocolate, Cod, Crab, Haddock, Ham, Lobster, Mackerel, Milk (cow and goat), Mutton, Oyster, Salmon, Scallop, Shrimp, Trout, Tuna, Turkey, Yeast, Yoghurt, Avocados.

Histamine receptors in the CNS

Ligand binding studies have shown H1, H2, H3 receptors in the CNS of uneven distribution.

Histamine receptors outside the CNS

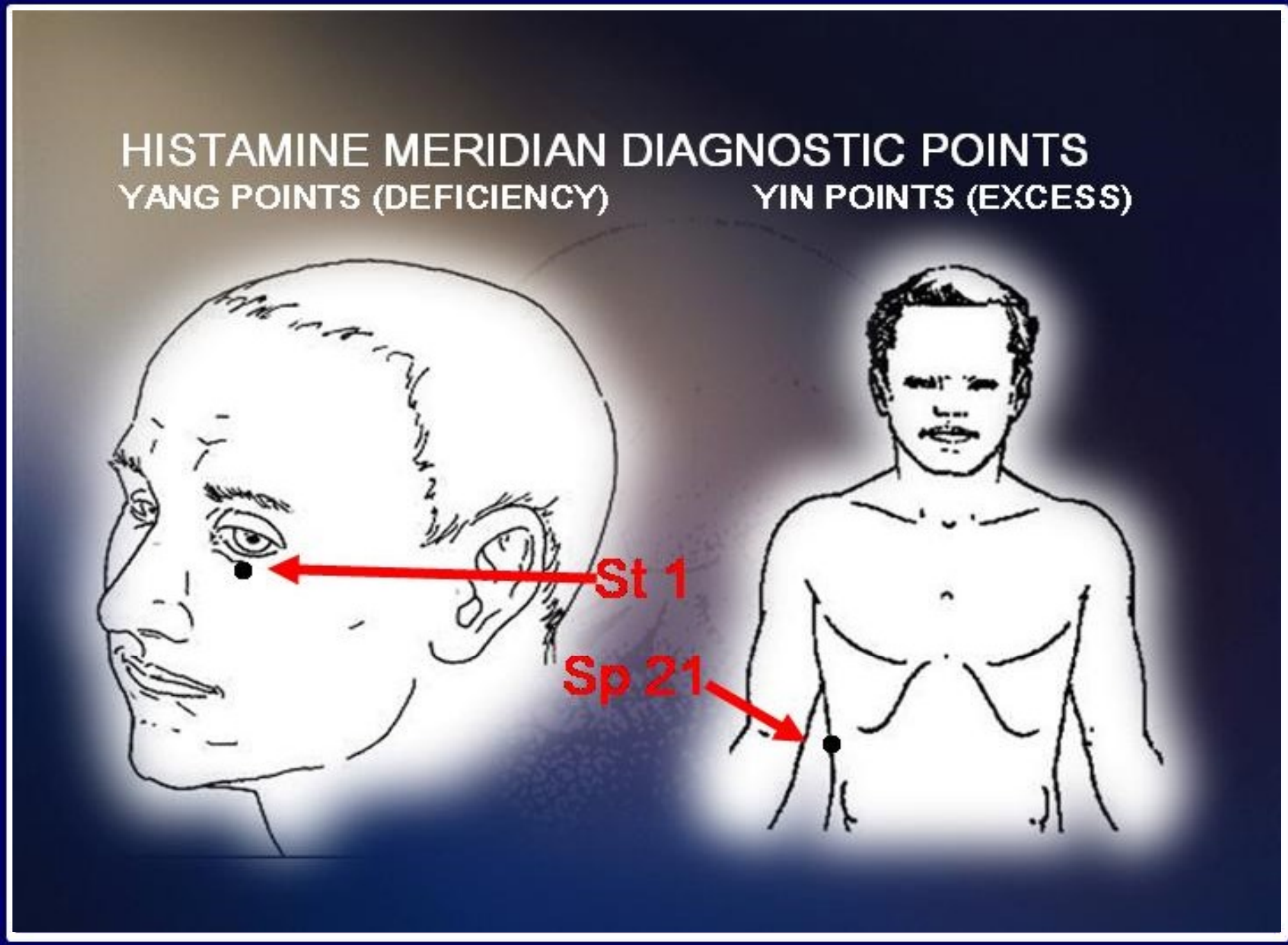
H1 receptors stimulation induces

- Brochoconstriction.
- Constriction of intestinal smooth muscle.
- Constriction of large arteries and veins.
- Relaxation of arterioles, small veins and capillaries especially in the brain.
- Increased capillary permeability
- **H2 receptor** stimulation induces gastric acid secretion.

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

SYMPTOMS

DEFICIENCY	EXCESS
Lethagy	*Aggitation*
↓ Hypochlorite production	↑ Hypochlorite production
Loss of libido	Allergy
Oedema	Asthma
Low immune function	Pain, redness, itching and Oedema
Stomach problems - hypochlorhydria	Spleen - Overactive immune responses


HISTAMINE MERIDIAN DIAGNOSTIC POINTS
YANG POINTS (DEFICIENCY)
YIN POINTS (EXCESS)
St 1
Sp 21

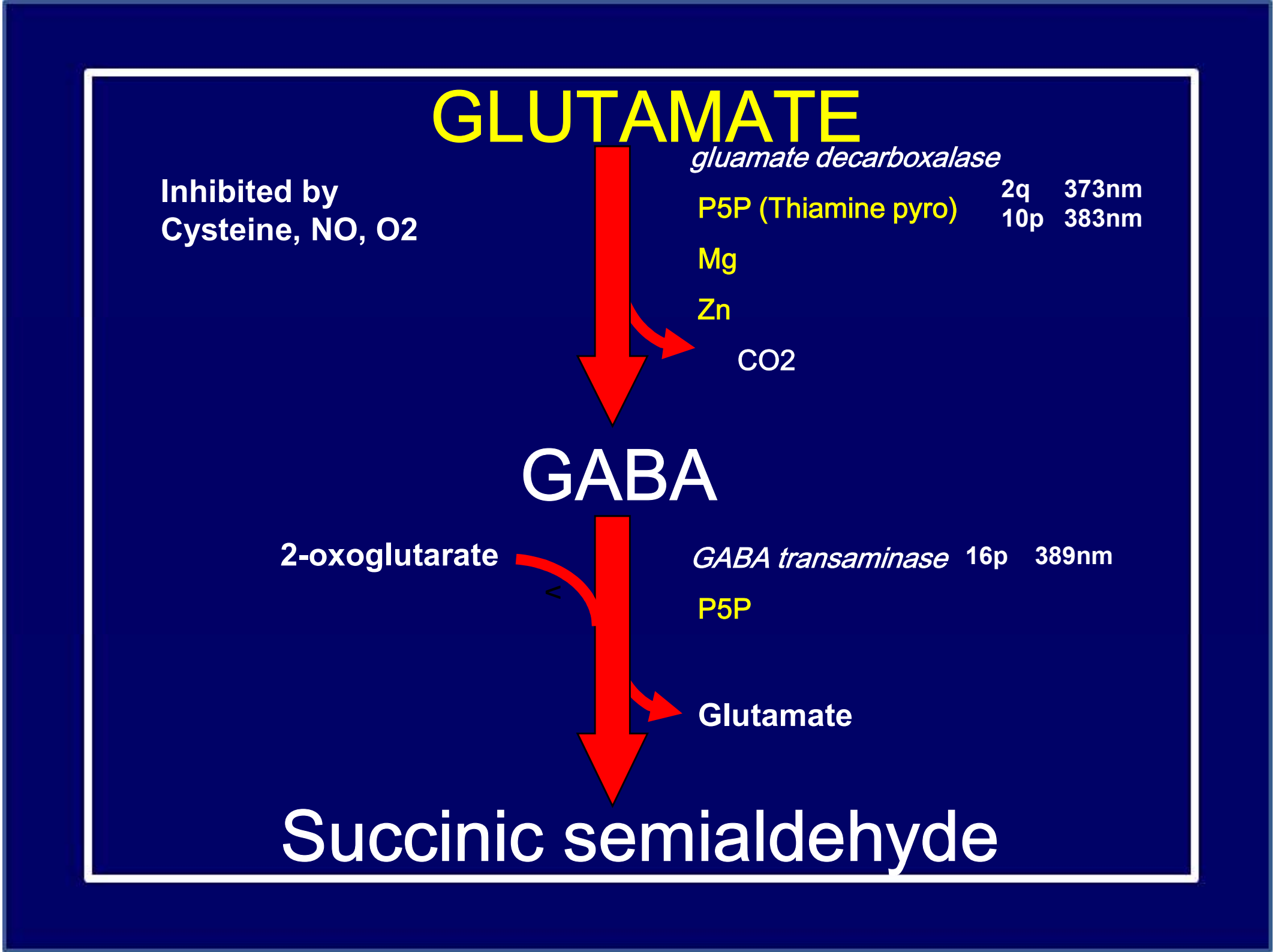
Exercises to stimulate Histamine

Dancing

Exercises to inhibit Histamine

Stretching, Mobility exercises, Flexibility, Oxygenation.

GABA


GLUTAMATE
gluamate decarboxalase
Inhibited by
Cysteine, NO, O2
P5P (Thiamine pyro)
2q 373nm
10p 383nm
Mg
Zn
CO2
GABA
2-oxoglutarate
GABA transaminase 16p 389nm
P5P
Glutamate
Succinic semialdehyde

GABA is an inhibitory neurotransmitter in parts of

1. The brain especially the cortex, hypothalamus, basal ganglia, cerebellum and hippocampus
2. Substantia gelatinosa of the dorsal horn of the spinal cord
3. Retina- It is not present in peripheral nerves

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

GABA receptors

GABA A receptor stimulation leads to an increase in chloride ion permeability.

They are present mainly in the cerebral cortex and the hippocampus.

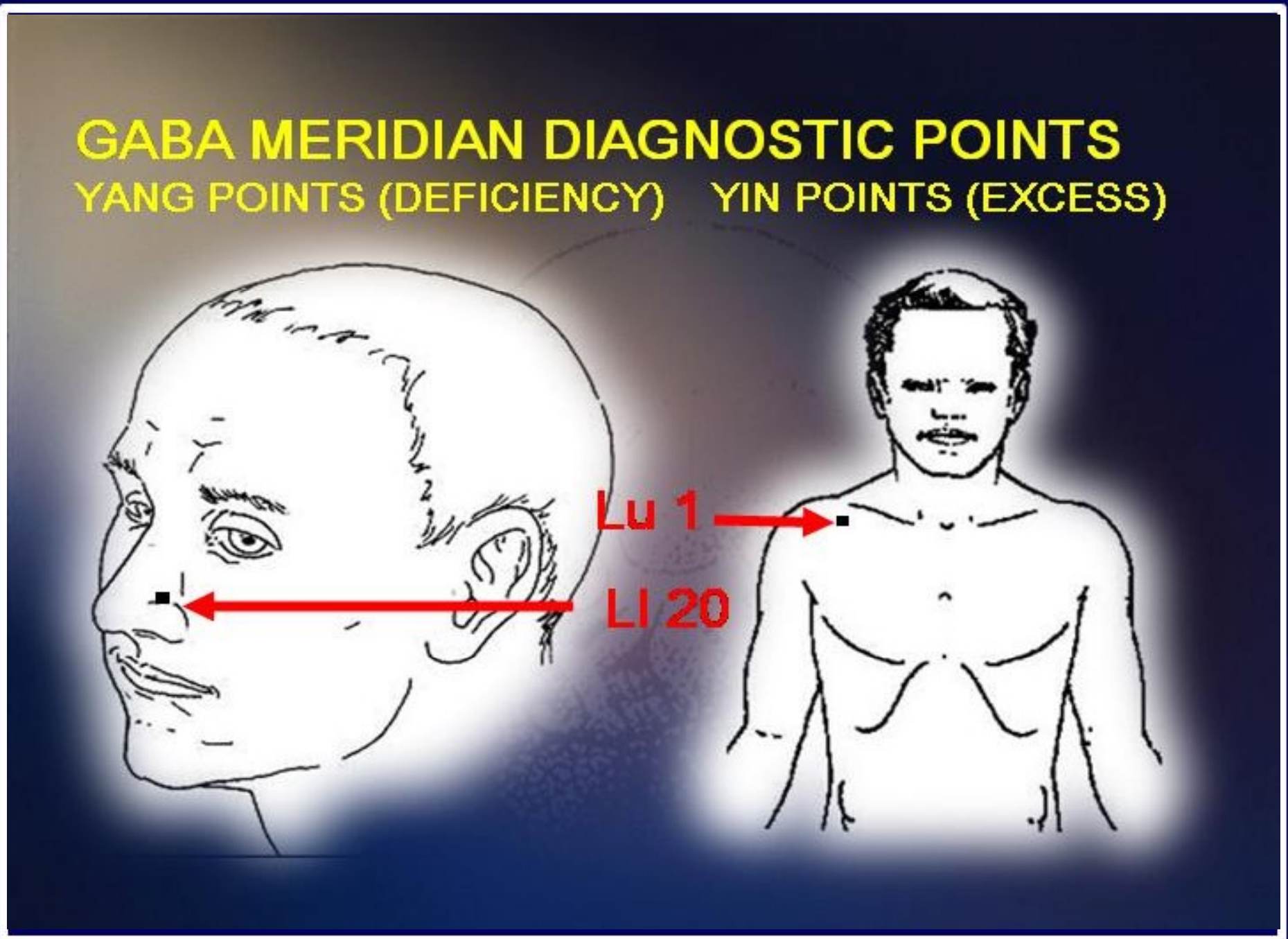
GABA B receptor stimulation leads to changes in potassium conduction. They are present mainly in the cerebellum and spinal cord.

GABA C receptor for *benzodiazepine and ?Barbiturate*

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

Symptoms

DEFICIENCY	EXCESS
Apathy and Despair ↓TH1 production Symptoms of Glutamate excess Convulsions such as epilepsy. Tetany and spastic disorders such as torticollis. Decreased cerebellar reflexes. Extrapyramidal disorders such as dyskinesis. Lateral inhibition of the retina. Thalamic sensory disorders. Large intestine problems such as parasites / fungi	*Anger and Hate* ↑TH1 production Muscle relaxation. Stuttering (Phos serine) Lung problems


GABA MERIDIAN DIAGNOSTIC POINTS
YANG POINTS (DEFICIENCY)
YIN POINTS (EXCESS)
Lu 1
LI 20

Exercises to stimulate GABA

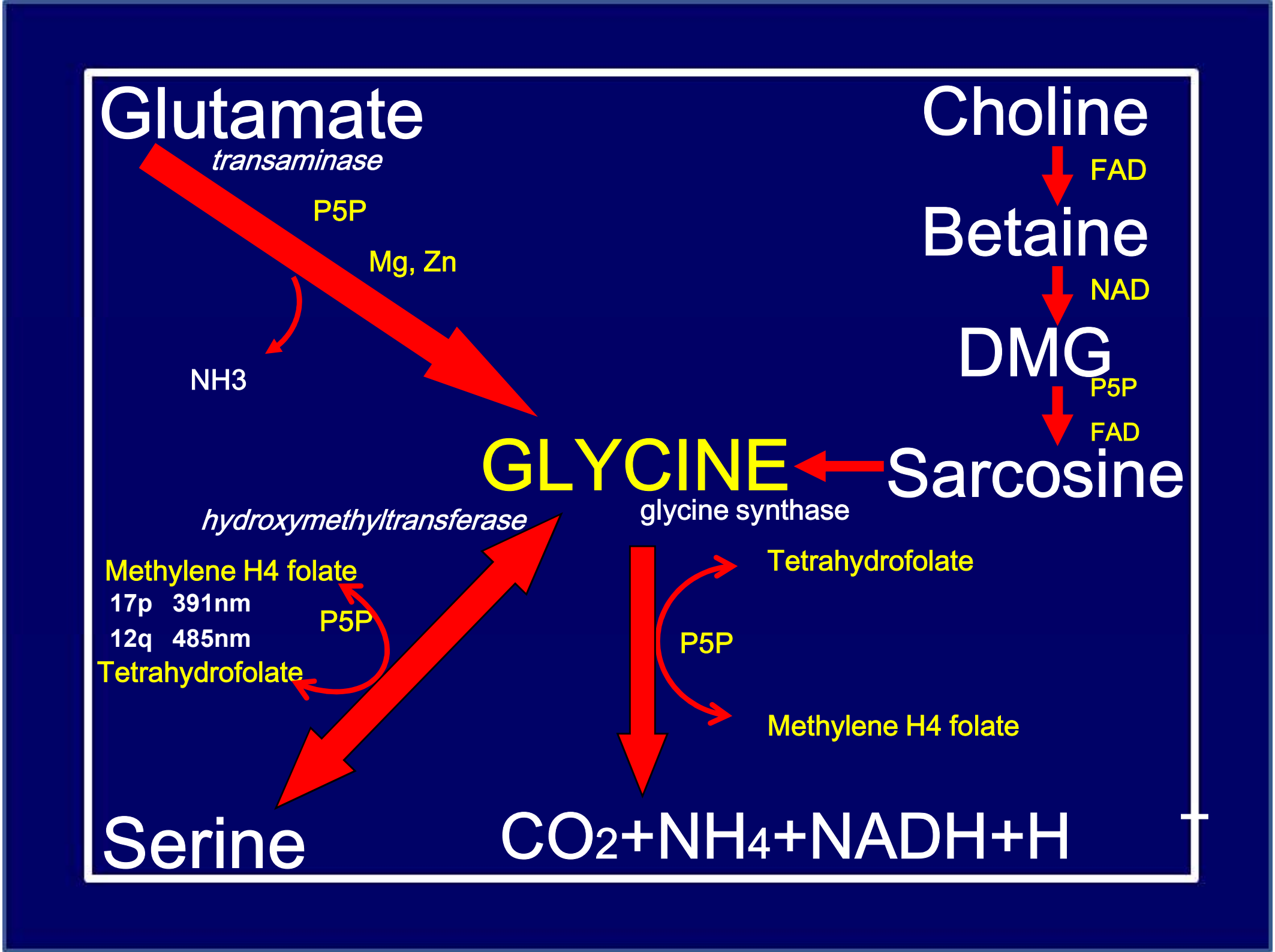
Golf

Exercises to inhibit GABA

Skipping, opens up, improves oxygenation, coordination.

National Skipping Day is on 13th March this year,

Glycine


Glutamate
transaminase
P5P
Mg, Zn
NH3
Choline
FAD
Betaine
NAD
DMG
P5P
FAD
Sarcosine
GLYCINE
glycine synthase
hydroxymethyltransferase
Methylene H4 folate
17p 391nm
12q 485nm
Tetrahydrofolate
P5P
Tetrahydrofolate
P5P
Methylene H4 folate
Serine
CO2+NH4+NADH+H

Glycine is an inhibitory neurotransmitter at some pathways in the

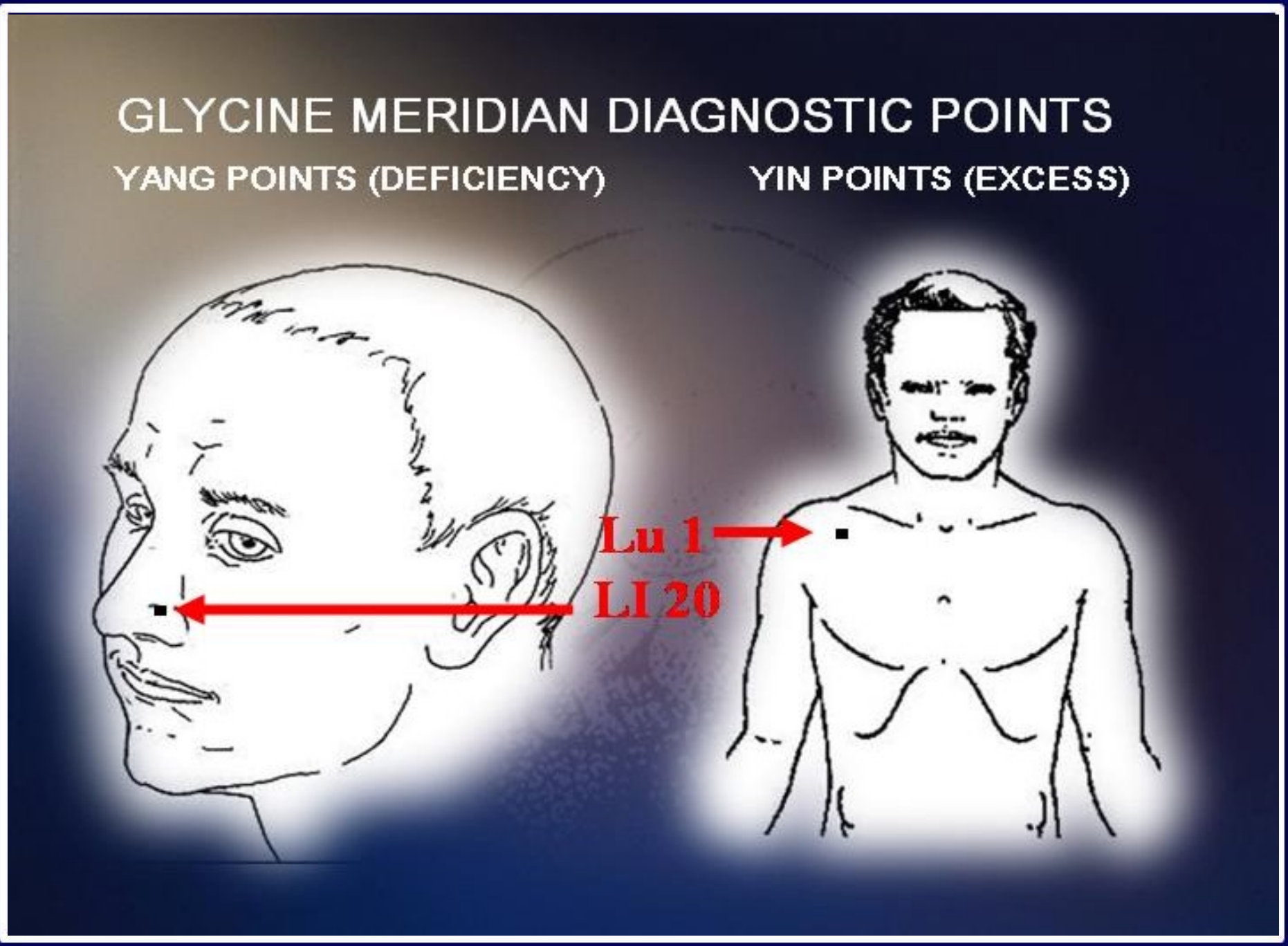
1. spinal cord
2. retina
3. brainstem and forebrain

Glycine is a free form amino acid found in protein foods and can be synthesised from glutamate, alanine, serine, choline via DMG and from carbohydrates.

Glycine receptors are blocked by strychnine.

SYMPTOMS

DEFICIENCY	EXCESS
Apathy and despair.	Anger and hate
Anxiety (loss of inhibition)	Stuttering (Phosphatidyl serine)
Symptoms of glutamate excess.	Snoring
Motor neurone spasticity	
Large intestine problems such as parasites / fungi	Lung problems


GLYCINE MERIDIAN DIAGNOSTIC POINTS
YANG POINTS (DEFICIENCY)
YIN POINTS (EXCESS)
Lu 1
LI 20

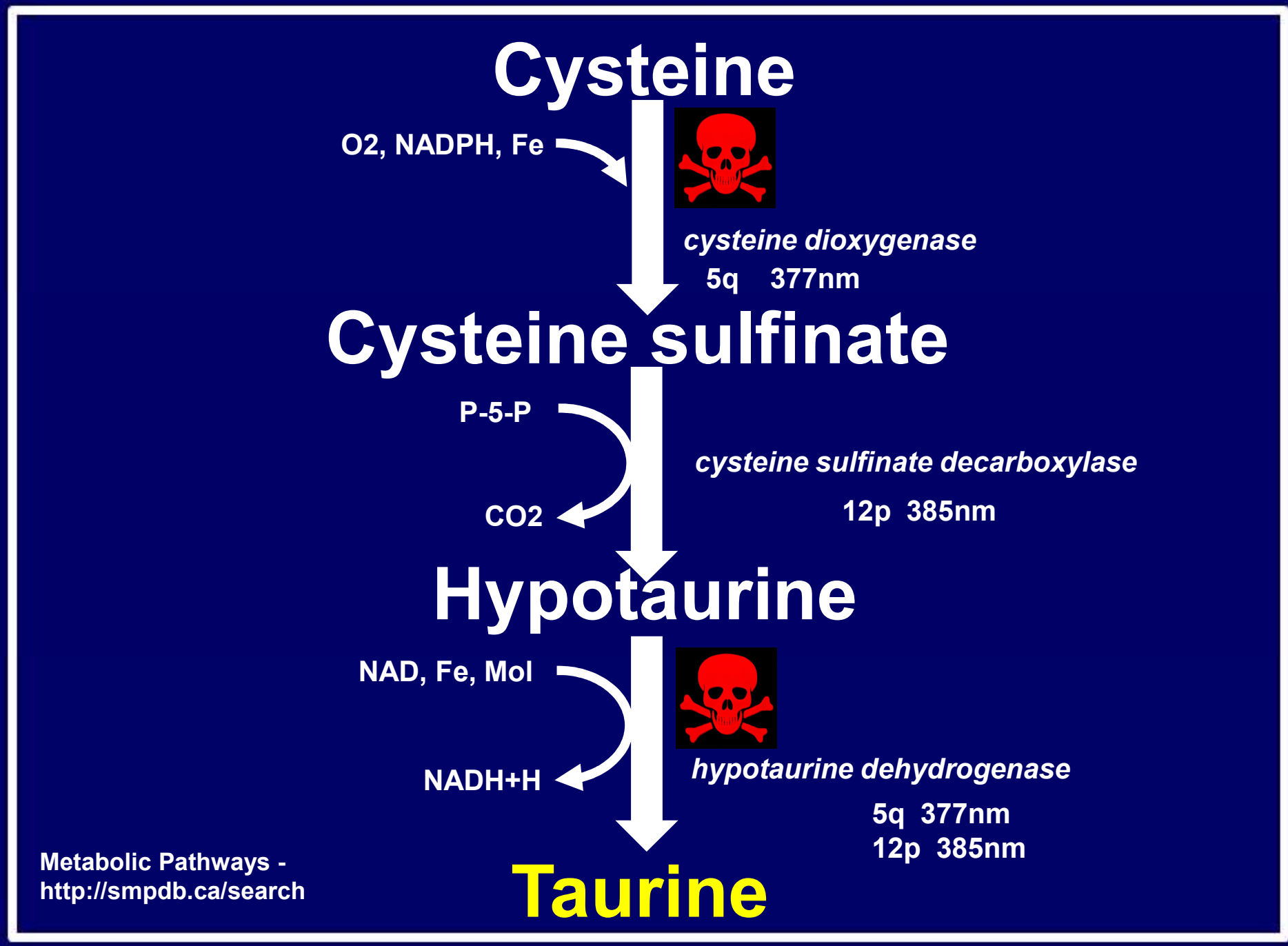
Exercises to stimulate Glycine

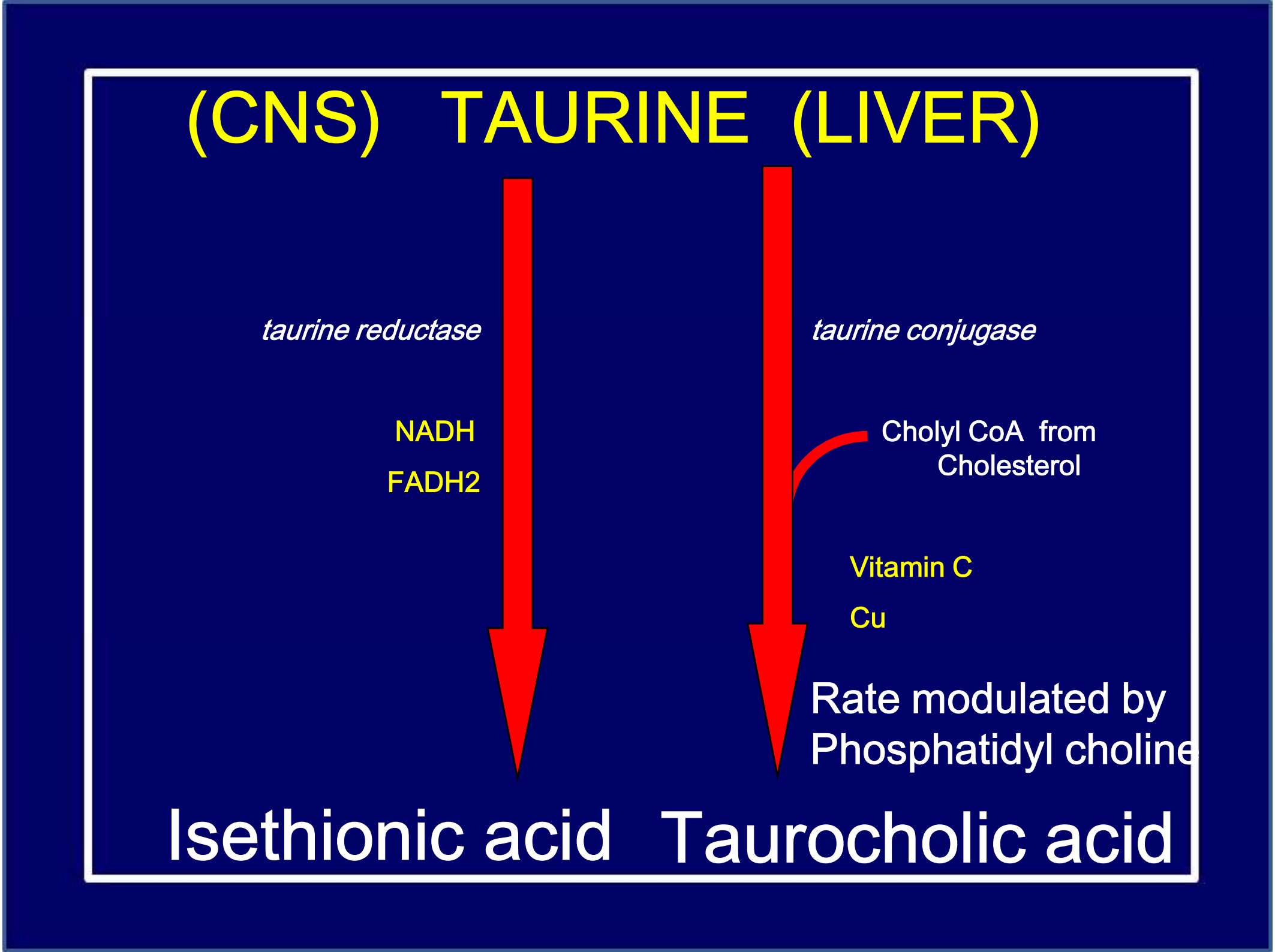
Golf

Exercises to inhibit Glycine

Skipping, opens up, improves oxygenation, coordination.

Taurine


Cysteine
O2, NADPH, Fe
cysteine dioxygenase
5q 377nm
Cysteine sulfinate
P-5-P
CO2
cysteine sulfinate decarboxylase
12p 385nm
Hypotaurine
NAD, Fe, Mol
NADH+H
hypotaurine dehydrogenase
5q 377nm
12p 385nm
Taurine
Metabolic Pathways -
http://smpdb.ca/search


(CNS) TAURINE (LIVER)
taurine reductase
NADH
FADH2
taurine conjugase
Cholyl CoA from Cholesterol
Vitamin C
Cu
Rate modulated by Phosphatidyl choline
Isethionic acid
Taurocholic acid

Taurine is the most abundant amino acid in the body and acts as an inhibitory or neuro-modulatory neurotransmitter at some pathways in the

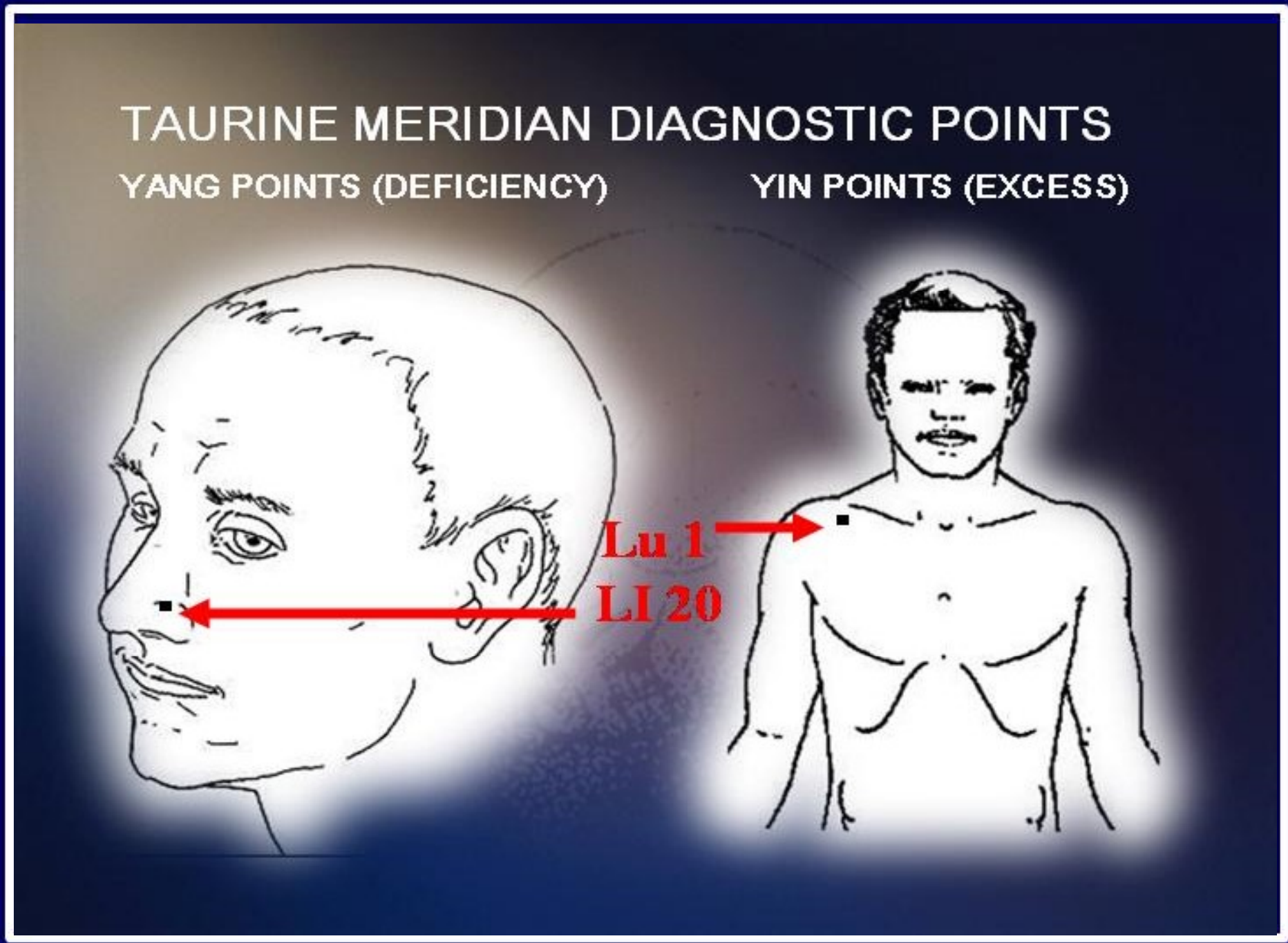
1. Brainstem
2. Retina at the inner plexiform layer
3. Striated muscles

Neurotransmitters and Drugs by Z. Kruk and C. Pycock.

Taurine receptors are blocked by **strychnine.**

Symptoms

DEFICIENCY	EXCESS
Apathy and despair. Anxiety	Anger and hate
Hypercholesteroleamia	Stuttering
Muscular dystrophies	Lung problems
Photoreceptor degeneration	
Retinitis pigmentosa	
Toxicity	
Large intestine problems	


TAURINE MERIDIAN DIAGNOSTIC POINTS
YANG POINTS (DEFICIENCY)
YIN POINTS (EXCESS)
Lu 1
LI 20

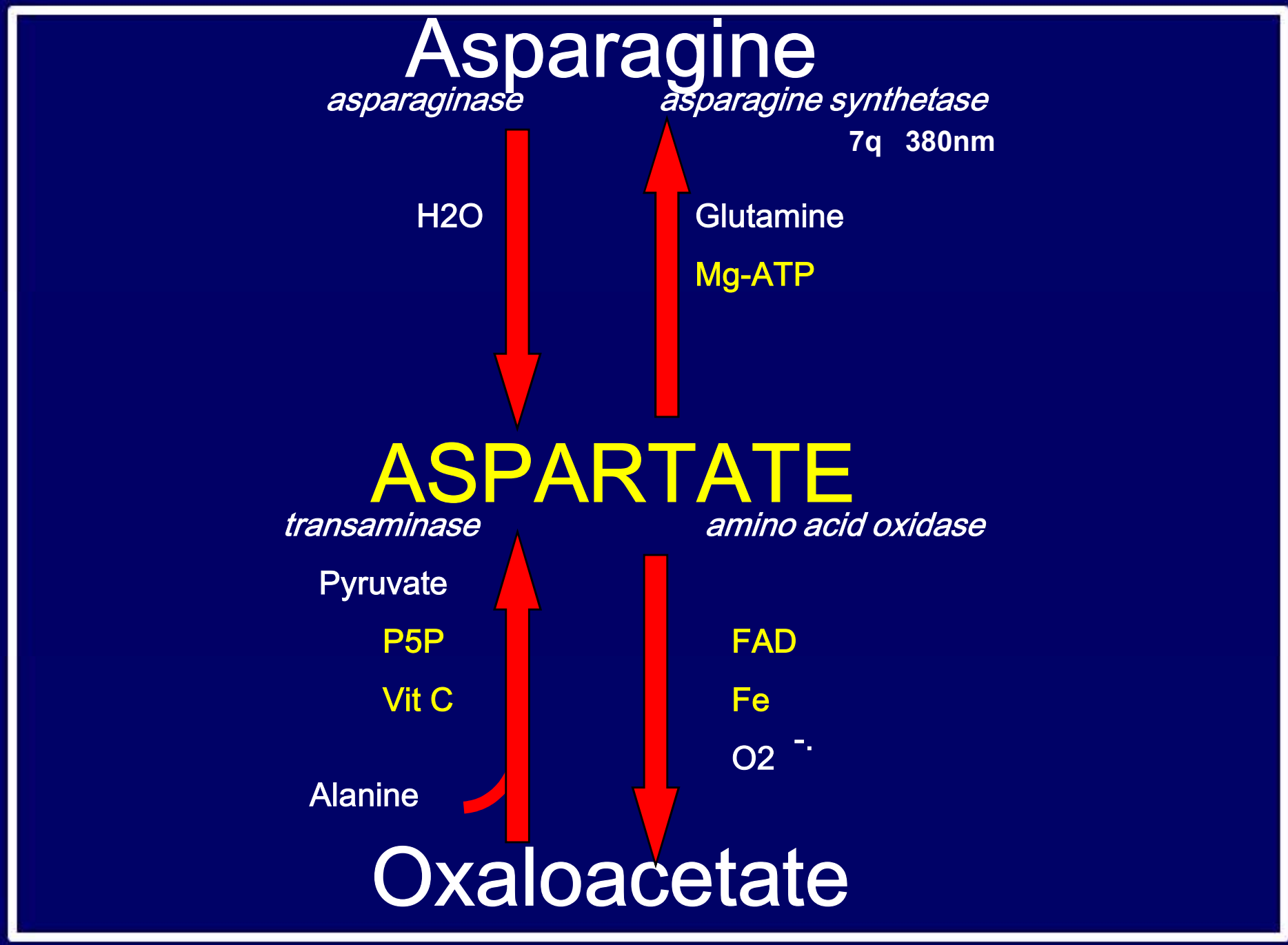
Exercises to inhibit Taurine

Skipping, opens up, improves oxygenation, coordination.

EXCITATORY NEUROTRANSMITTERS

(open Na^+, K^+ and / or Ca^{++} channels causing multiple depolarisation or stimulation

Aspartic acid (Aspartate)


Asparagine
asparaginase
asparagine synthetase
7q 380nm
H2O
Glutamine
Mg-ATP
ASPARTATE
transaminase
amino acid oxidase
Pyruvate
P5P
Vit C
Alanine
FAD
Fe
O2 -.
Oxaloacetate

RECEPTORS

Aspartate and Glutamate receptors occur throughout the CNS.

ASPARTATE RECEPTORS

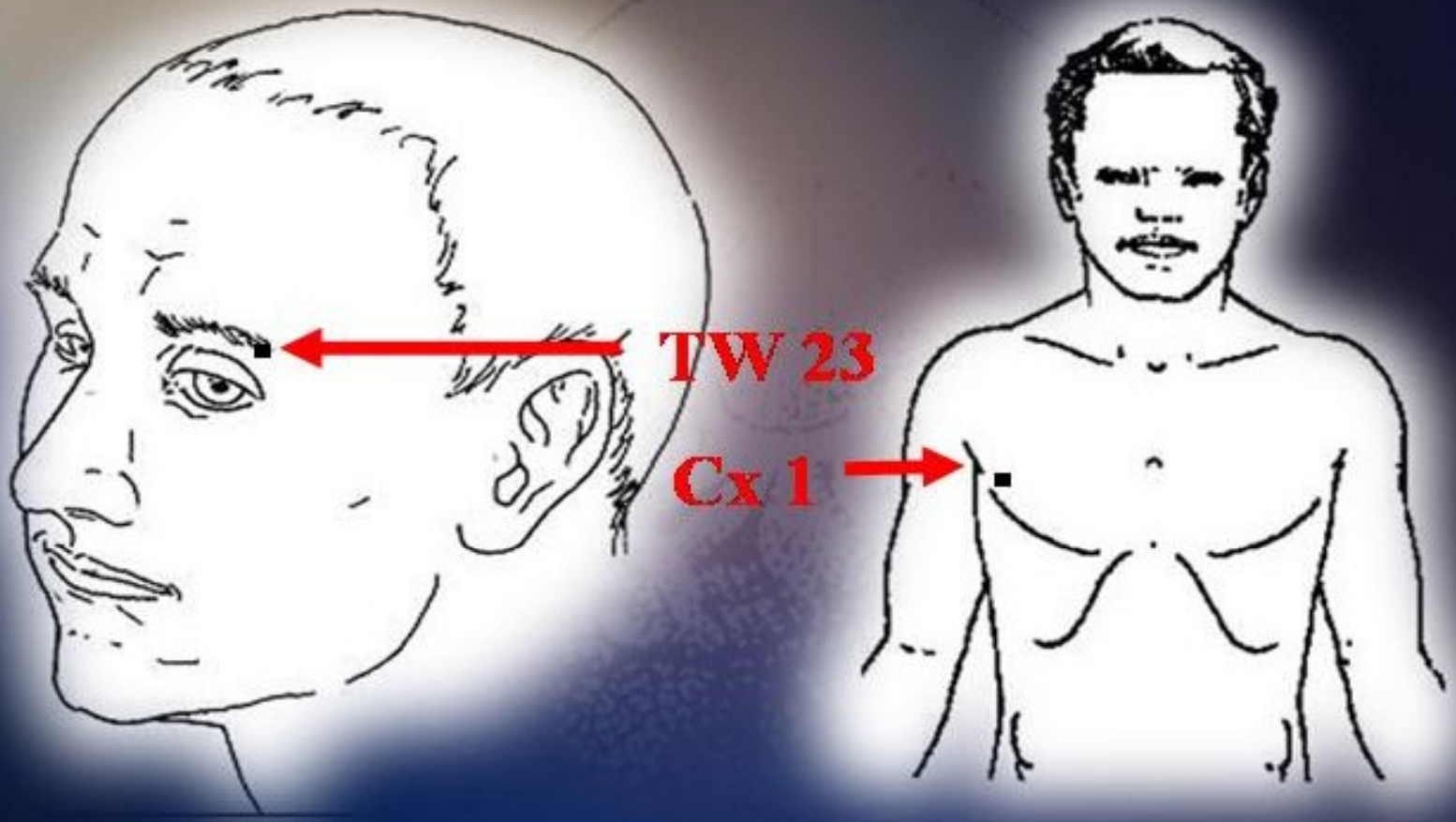
Aspartate receptors are located in the dorsal and ventral grey matter where they cause excitation of spinal excitatory interneurones where it may regulate motor and spinal reflexes and in the retina of the eye.

SYMPTOMS

DEFICIENCY	EXCESS
Aimless	Manic
↓NO production	↑NO production
Learning disorders	High libido due to high NO
Weight gain	Hyperactivity
Loss of libido due to low NO	ADDH / Dyslexia / Amnesia
Memory loss	Muscle spasm, Restless legs
Hypothyroidism	Nystagmus and Tinnitus
	Irritable Bowel Syndrome
	Chronic Fatigue Syndrome
	Fibromyalgia
	Convulsions / Epilepsy
	Hyperthyroidism

EXCITATORY MERIDIAN DIAGNOSTIC POINTS

YANG POINTS (DEFICIENCY) **YIN POINTS (EXCESS)**



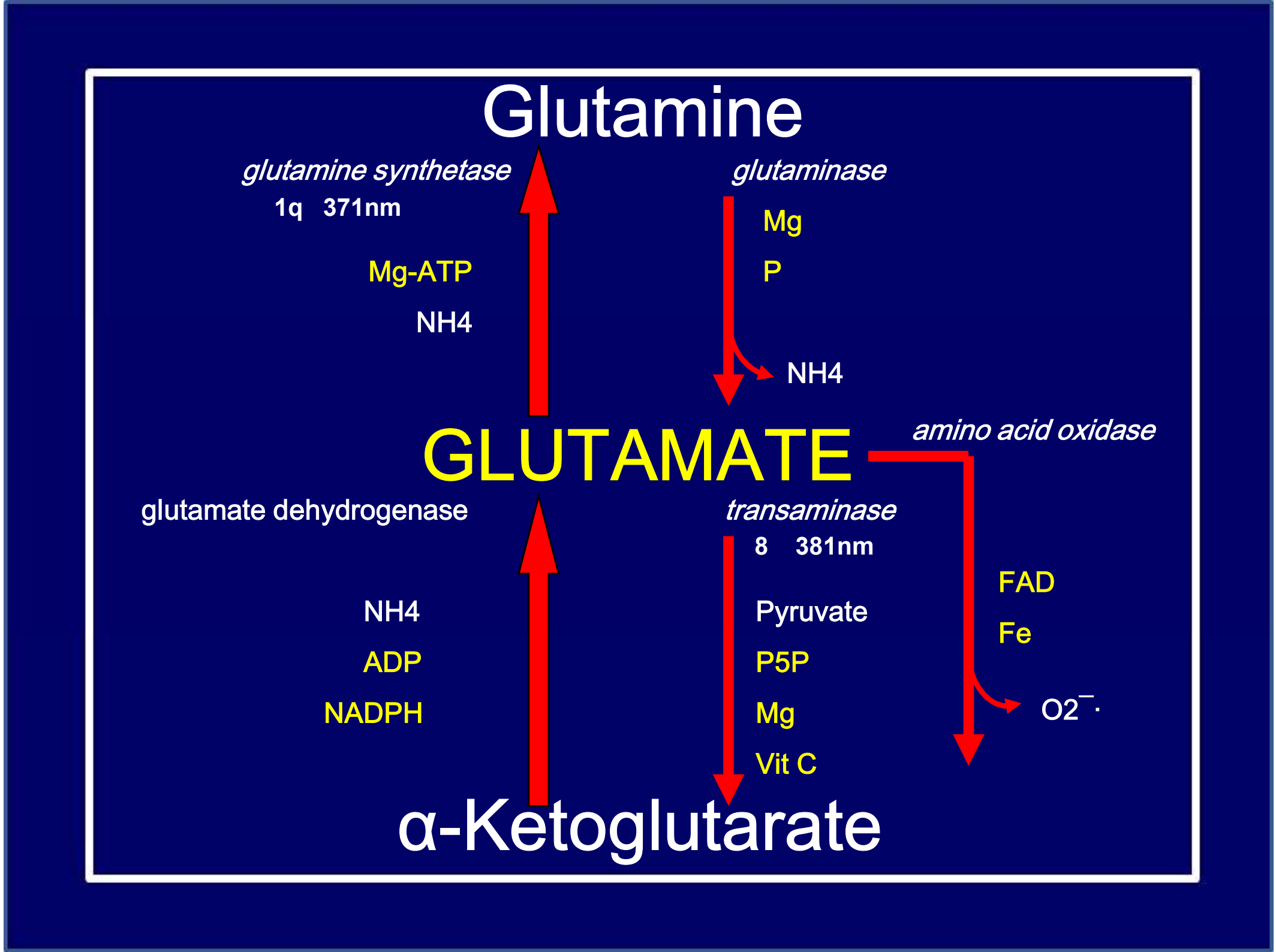
Exercises to stimulate Excitatory

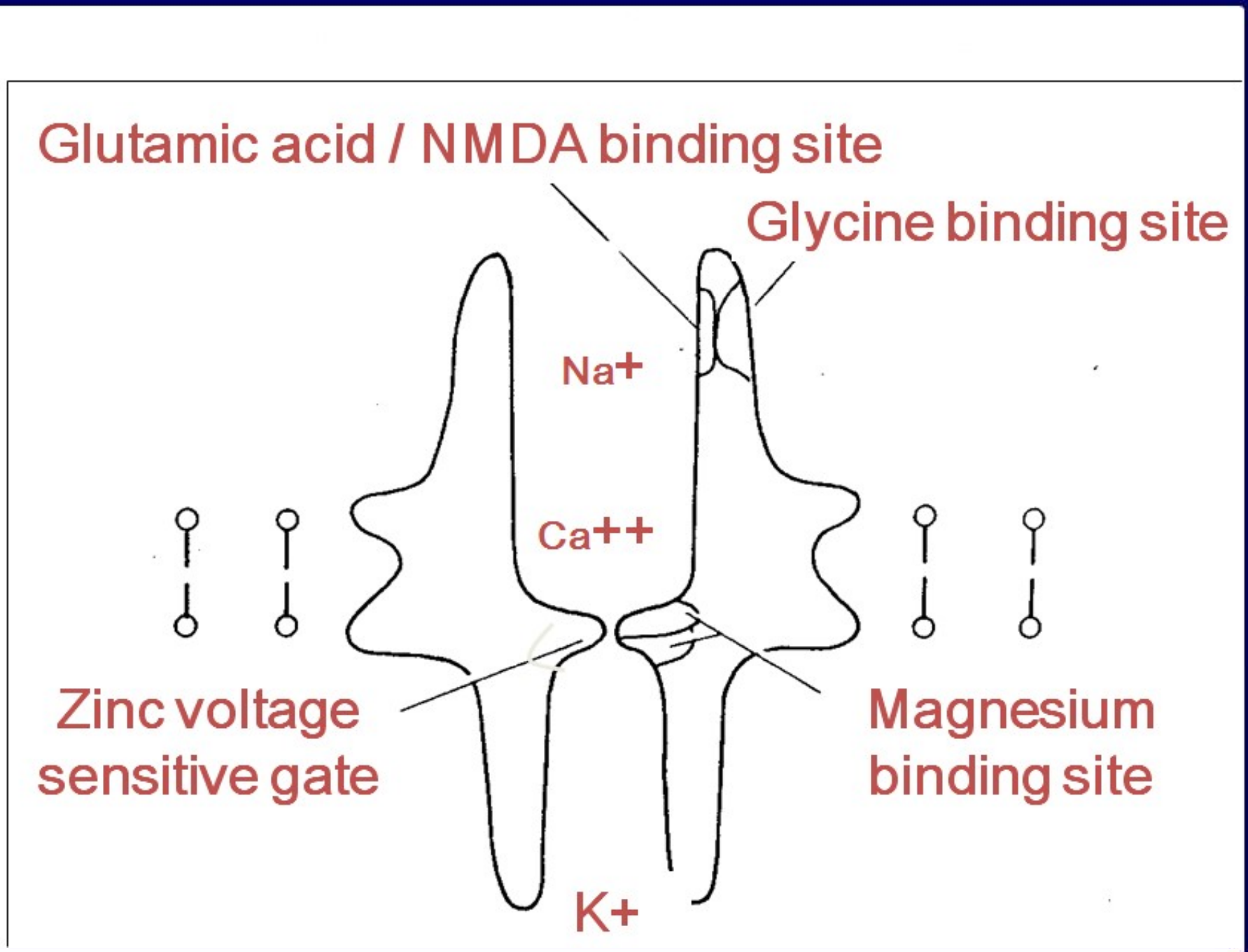
Skating – ice skating, roller blading, scooting.

Exercises to inhibit Excitatory

Interval training (fast / slow to break up hyper states.)

Glutamic acid (Glutamate)


Glutamine
glutamine synthetase
1q 371nm
Mg-ATP
NH4
glutaminase
Mg
P
NH4
GLUTAMATE
amino acid oxidase
FAD
Fe
O2¯·
glutamate dehydrogenase
NH4
ADP
NADPH
transaminase
8 381nm
Pyruvate
P5P
Mg
Vit C
α-Ketoglutarate


Glutamic acid / NMDA binding site
Glycine binding site
Na+
Ca++
Zinc voltage sensitive gate
Magnesium binding site
K+

RECEPTORS

Aspartate and Glutamate receptors occur throughout the CNS.

Glutamate receptors

In the spinal cord glutamate receptors are most concentrated at the primary afferent fibres in the dorsal roots and may serve to relay sensory information and to regulate motor activity and spinal reflexes.

In the brain glutamate receptors are found in high concentration in the cortex, hippocampus, neostratum and cerebellum with lower levels in the hypothalamus. They are also present in the retina of the eye.

SYMPTOMS

DEFICIENCY	EXCESS
Aimless	Manic
↓NO production	↑NO production
Learning disorders	High libido due to high NO
Weight gain	Hyperactivity
Loss of libido due to low NO	ADDH / Dyslexia / Amnesia
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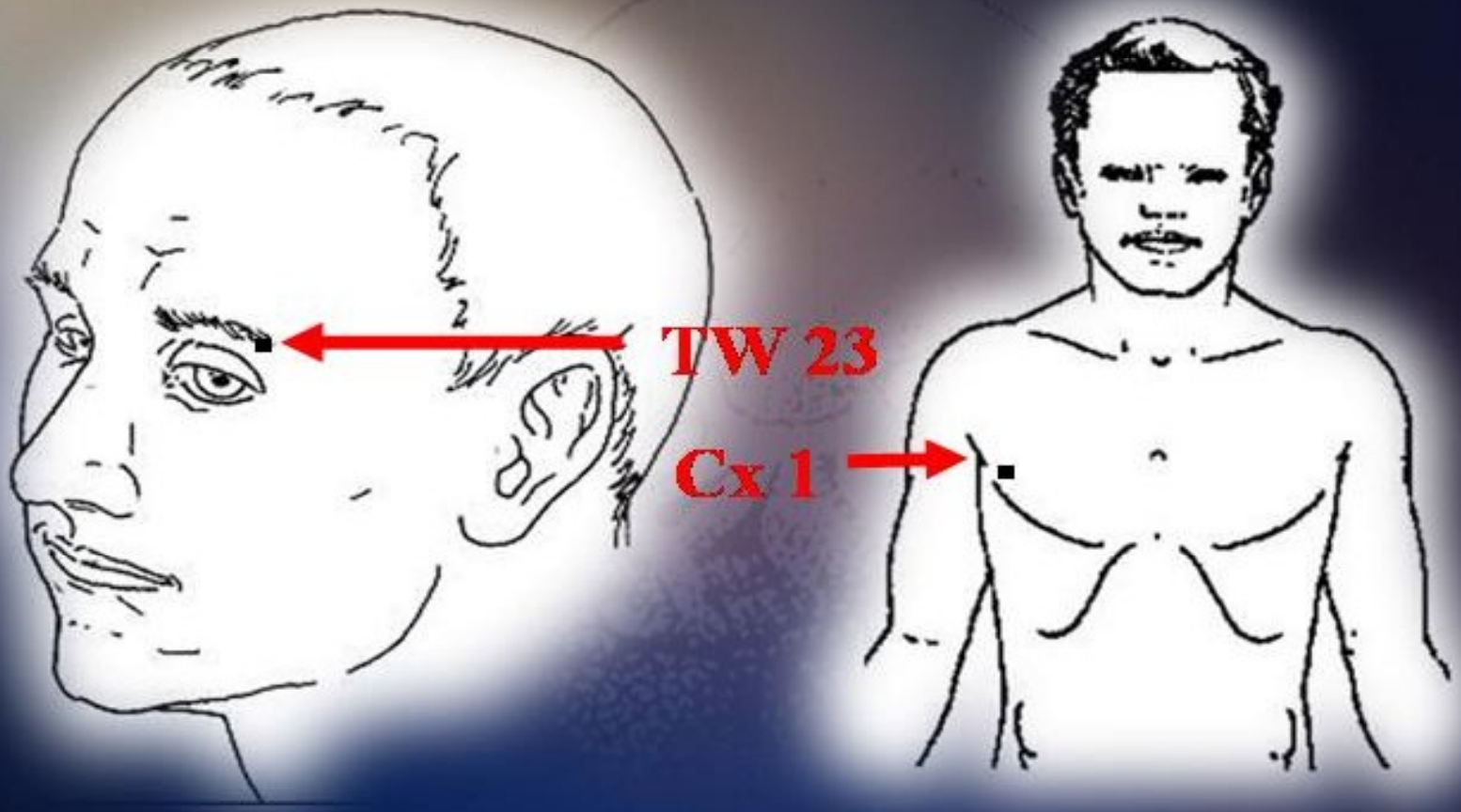
	Irritable Bowel Syndrome
	Chronic Fatigue Syndrome
	Fibromyalgia
	Convulsions / Epilepsy
	Hyperthyroidism

EXCITATORY MERIDIAN DIAGNOSTIC POINTS

YANG POINTS (DEFICIENCY)

YIN POINTS (EXCESS)



Exercises to stimulate Excitatory

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Exercises to inhibit Excitatory

Interval training (fast / slow to break up hyper states.)

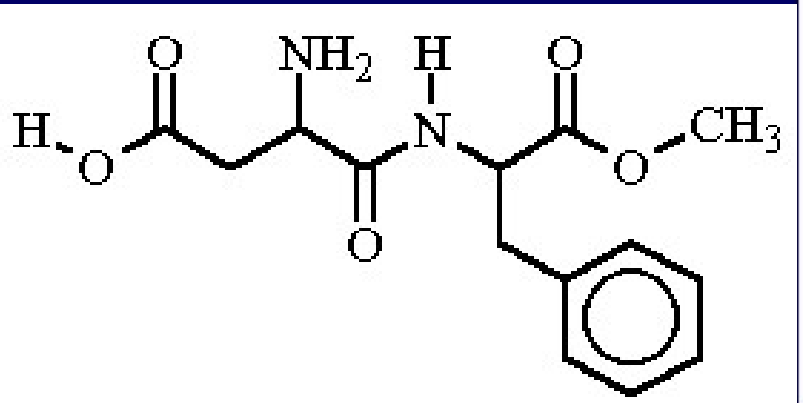
ASPARTAME and DEPRESSION

Aspartame decreases the availability of Tryptophan to the brain.

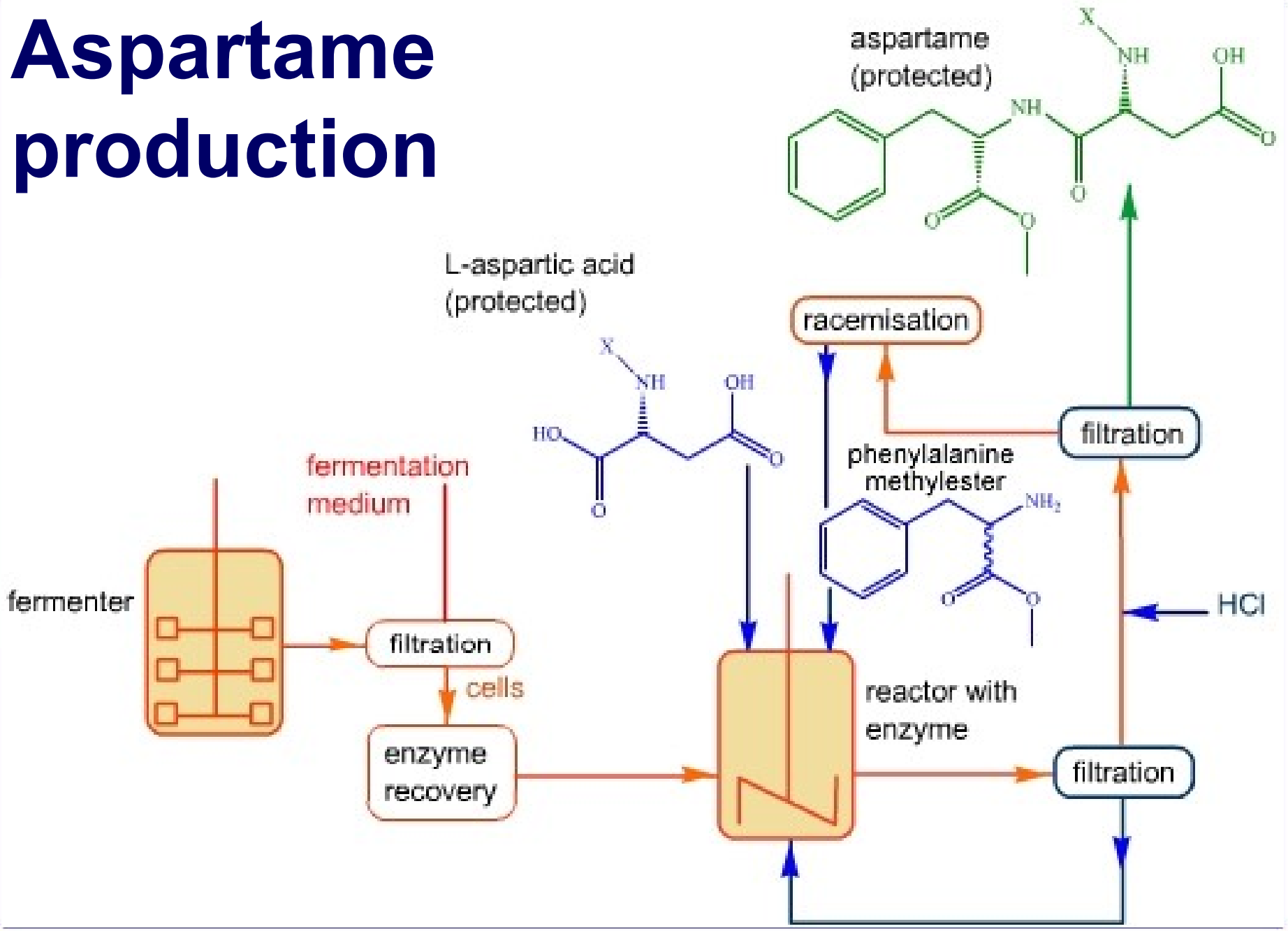
Tryptophan is the essential amino acid building block to serotonin, which when present in the brain in low amounts leads to depression
and compulsive disorders.

ASPARTAME DEGREDATION

ASPARTAME
is
ASPARTIC ACID
+
PHENYLALANINE



Aspartame production



Ingested and warmed to body temperature 37° c it is activated upon by

Chymotrypsin

With the creation of methanol in the ileum.

Lin SY, Cheng YD (October 2000). "Simultaneous formation and detection of the reaction product of solid-state aspartame sweetener by FT-IR/DSC microscopic system". Food Additives and Contaminants. 17 (10): 821–7

Methanol is oxidised to formaldehyde and formic acid

Trocho C, Pardo R, Rafecas I, Virgili J, Remesar X, Fernández-López JA, Alemany M (1998). "Formaldehyde derived from dietary aspartame binds to tissue components in vivo". *Life Sciences*. 63(5): 337–49