

Biomedical Science Glossary

An Introduction to the Vocabulary and Concepts of Biomedical Science for Non-Specialists (That They Might Better Understand their Own Sciences)

Copyright Notice: This material was written and published in Wales by Derek J. Smith (Chartered Engineer). It forms part of a multfile e-learning resource, and subject only to acknowledging Derek J. Smith's rights under international copyright law to be identified as author may be freely downloaded and printed off in single complete copies solely for the purposes of private study and/or review. Commercial exploitation rights are reserved. The remote hyperlinks have been selected for the academic appropriacy of their contents; they were free of offensive and litigious content when selected, and will be periodically checked to have remained so. **Copyright © 2024-2025, Derek J. Smith.**



Drydain fawr
o
Drydain fore



First published 12:00 BST 8th October 2024. This version dated 09:00 GMT 10th March 2025

BUT UNDER DAILY EXTENSION AND CORRECTION, SO CHECK AGAIN SOON

That we may "make our own miracles" ("[Lorenzo's Oil](#)")

EDITORIAL NOTE: The level of technical detail provided in this resource is intended to inform *non-specialists* in the area in question while at the same time - for advanced students - identifying the relevant laboratory research, both classical and cutting edge. Where non-peer reviewed material (such as the frequent YouTube tutorials) is used, both content and source have been carefully evaluated.

Acetyl CoA: See **Krebs cycle**.

Aconitase: See **Krebs cycle**.

Adenosine Triphosphate (ATP): See **Krebs cycle**.

Alanine Transaminase (ALT) [[Wikipedia briefing](#)]: See **liver function tests (LFTs)**.

Amygdala: See [companion resource](#).

Apoptosis: See **cell death, types of**.

Archaea [[Wikipedia briefing](#)]: A species *domain* of asexually reproducing **prokaryotes** similar to (and easy to conflate with) **bacteria**, and possessing many primitive biochemical abilities seen later (presumably as the result of **endosymbiosis**) in later **eukaryotes** (including vertebrates) ^{Footnote 1}. Archaea are potentially the oldest life form on earth, and still all around us, often specialising in extreme environments like hot springs and - as *mutualists* - in animal gut **microbiota** (where their niche chemistry helps digestion).

! The words "seen later in" have two significant meanings: FIRSTLY, archaea are physically present in their trillions in each reader's gut microbiota (unless suppressed by antibiotics), and SECONDLY, genetic sequences originally developed by archaea are tucked away in each reader's personal DNA as a result of the endosymbiosis mentioned above - that is to say, they are our distant ancestors!!

Armstrong, Ashley and Sarah [[corporate biography](#)]: American fringe [= green experimentalist] agriculturalists Ashley and Sarah Armstrong are the public face of **ArmstrongSisters** [[commercial homepage](#)] and the associated **Nourish Food Club** [[commercial homepage](#)], a back-to-basics farming cooperative. With qualifications in engineering and bioscience, they run experimental farms in Michigan, producing high-specification, traditionally-reared cattle, swine, goats, sheep, and

poultry. They eschew factory farming methods in general, and the use of PUFA-contaminated feed additives in particular ...

ASIDE - DOES BIG FOOD KNOW WHAT IT'S DOING?: The Armstrong sisters are focally critical of the usage of **dried distillers' grains with solubles (DDGS)** [see own entry **IMPORTANT PARALLEL NARRATIVE**] in the food chain. DDGS are the residues of the industrial distilling of corn mush to produce ethanol as a biofuel, a process which takes the carbohydrate and leaves not just the husk but also the fats, the protein, and any herbicides. It also peroxidises much of the fat in the process, creating **polyunsaturated fatty acids (PUFAs)** [see own entry **IMPORTANT PARALLEL NARRATIVE**]. The process produces 2.6 kilograms of DDGS for every gallon of ethanol obtained, **and this is now incorporated into animal feed in hundreds of thousands of tons.** These PUFAs are believed NOT JUST to poison the livestock in question BUT ALSO to pass through the herds and flocks into their meat (both lean and fatty tissue) and derivative dairy products/eggs. At the same time, PUFAs are known (1) to double the Omega-6 assay for brain tissue, and (2) to cause behaviourally significant neurological damage. The PUFAs most directly of concern are **oxidised linoleic acid metabolites (OXLAMS)** [see own entry **IMPORTANT**].

Ashley Armstrong has fronted the sisters' online marketing campaign since 2021, and her YouTube sales pitches provide valuable background science *en passant*, thus ...

[YouTube typical presentation](#) (10 mins.)

[YouTube typical presentation](#) (13 mins.)

RESEARCH ISSUE - WHY MIGHT THIS MATTER: We have already noted the core problem in the **PUFA explanations of disease and lipid peroxidation** entries. Readers may be interested in raising *PubMed* alerts for future publications by PUFA researchers such as **Theodore P. Beauchaine** and **Elise M. Cardinale**.

Aspartate Aminotransferase (AST) [[Wikipedia briefing](#)]: See **liver function tests (LFTs)**.

"The next most stable arrangement of electrons is the octet" (Langmuir, *op. cit. inf.*)

Atomic Bonding for Non-Chemists: This is a question which goes back a long way ...

CAMEO #1 - ANCIENT NUCLEAR THEORY: Some 2500 years ago, the Greek philosopher **Democritus** [[Wikipedia biography](#)] was the first recorded nuclear physicist, arguing from contemplated observation alone that if you kept dividing any substance you would eventually end up with something too small to see but incapable of further division. He described these ultimate components of matter as *atomos* [ἀτόμος un-sliceable], a notion which would pervade scientific thinking until modern theories of the atom started to appear in the early 19th century.

Little was then said on the matter until the early years of the modern scientific age [which we date for our present purposes to the founding, in 1660, of *The Royal Society* - Ed.] ...

CAMEO #2 - COMPILING THE PERIODIC TABLE, EARLY THOUGHTS: The facts that not all elements react together, but that those which did so in simple proportions, have long been explained away as due to some as-yet-unexplained "affinity" to combine, which particular atoms either had or did not have. This, for example, had been the opinion of Isaac Newton in his 1704 treatise on "**Opticks**" [[Amazon](#)], in which he used terms such as "the Attraction" of "small Particles of Bodies" (p305, Quest. 31), whose "Causes [remained] to be found out" (*ibid.*, p325). The first attempt at a periodic table of the elements sequenced by **atomic weight** was then by one **John Dalton** [[Wikipedia biography](#)] in his 1808-1827 (various editions) "**New System of Chemical Philosophy**" [full text online (courtesy of the Science History Institute) **A SIGNIFICANT HISTORICAL CLASSIC**]. This was followed in 1829 by **Johann Döbereiner's** [[Wikipedia biography](#)] observation that many of the 53 elements known at that time displayed common properties *in sets of three*, soon to be dubbed "**Döbereiner's Triads**" [[Wikipedia briefing](#)]. By the mid-19th century it had been well established (1) that elements are better sorted by their **atomic number** than atomic weight, (2) that there existed runs of elements with this or that "periodicity" [= notable recurrence] of property, and (3) that somehow this all had something to do with the older problem of "affinity" to react. Indeed the term "valency" was coined in 1852 [full text online (courtesy of *The Royal Society*)] by the British chemist **Edward Frankland** [[Wikipedia biography](#)] specifically to reflect on that latter problem.

CAMEO #3 - COMPILING THE PERIODIC TABLE, THE BREAKTHROUGH: The early works were followed in 1864 by **Lothar Meyer's** [[Wikipedia biography](#)] "**Die modernen Theorien der Chemie**" [[Amazon](#)], in 1865 by **John Newlands'** [[Wikipedia biography](#)] "**On the Law of Octaves**" [[Amazon](#)], and in 1869 by **Dmitri Mendeleev's** [[Wikipedia biography](#)] "**Attempt at a System of Elements**" [[Amazon](#)]. Mendeleev's system is now

recognised as canonical thanks NOT ONLY to its ability to predict the positioning of elements still unknown, BUT ALSO to the concurrence between its observed regularities and the complexities of **electron orbitals** once they had been discovered by Rutherford and Bohr in the early 1900s. Here is a consolidating tutorial ...

[YouTube tutorial on the early years](#) ^(5 mins.)

CAMEO #4 - FROM "AFFINITY" VIA VALENCY TO COSMIC INEVITABILITY: Things came together in 1916/1919 when the old problem of combinatorial affinities - valencies - was re-couched into the language of electron orbitals by (independently) Germany's **Walter Kossel** [[Wikipedia biography](#); the paper "*Über Molekülbindung als Frage des Atombaus*" is not available online] and America's **Gilbert N. Lewis** [see the **Lewis dot system** entry] and **Irving Langmuir** [[Wikipedia biography](#); [full text online \(paywalled\)](#)]. In short, they argued, the electron shells on one atom were naturally arranged so as to present opportunities to interact inevitably with the electron shells in certain others, and - moreover - in ones, twos, threes, etc. Once you had atomic orbitals, in other words, those atoms would compound together into molecular hybridised orbitals **only when the mathematics of those orbitals permitted it**. It remained only for Nobel Prize winners **Erwin Schrödinger** [[Wikipedia biography](#)] to do the necessary math (1921-1926), and **Linus Pauling** [[Wikipedia biography](#)] to sum it all up (1931-1932).

FURTHER READING: The concepts introduced above are further explored in the more advanced entry for **atomic orbitals and electron domain geometry**.

ATP: See **Krebs cycle**.

Autophagy: See **cell death, types of**.

Bacteria [[Wikipedia briefing](#)]: A species *domain* of asexually reproducing, anuclear **prokaryotes** similar to (and easy to conflate with) the perhaps more ancestral **archaea**, and possessing many primitive biochemical abilities seen later (presumably as the result of **endosymbiosis**) in later **eukaryotes** (including vertebrates). Bacteria are some of the oldest life forms on earth, and still all around us, often specialising in recycling organic waste and - as *mutualists* - in animal gut **microbiota** (where their niche chemistry helps digestion in the host). It is even possible that *oxygenic photosynthesising* bacteria - that is to say, **cyanobacteria** - were (in part, at least) responsible for earth's atmospheric oxygen.

Basophil Count: See **routine bloods**.

Beauchaine, Theodore P. [[Wikipedia biography](#)]: American biological psychologist specialising in "the neural bases of behavioural impulsivity, emotional dysregulation, and self-injurious behaviour". See, for example, **Beauchaine (2015)**.

Beauchaine (2015): On 1st June 2015 the journal *Current Opinion in Psychology* published a paper by Ohio State University's **Theodore P. Beauchaine** titled "**Respiratory Sinus Arrhythmia: A Transdiagnostic Biomarker of Emotion Dysregulation and Psychopathology**" [[full text online](#)], in which reduced or abnormally labile **respiratory sinus arrhythmia (RSA)** [[Wikipedia briefing](#)] was proposed as a correlate of poor **emotional regulation (ER)** [[Wikipedia briefing](#)]. Here is an indicative clip from the *Abstract* ...

"In the past two decades, respiratory sinus arrhythmia (RSA) [...] has emerged as a reliable peripheral biomarker of emotion regulation (ER). Reduced RSA and excessive RSA reactivity (i.e., withdrawal) to emotional challenge are observed consistently among individuals with poor ER capabilities, including those with various forms of internalizing and externalizing psychopathology, and those with specific psychopathological syndromes, including anxiety, phobias, attention problems, autism, callousness, conduct disorder, depression, non-suicidal self-injury, panic disorder, and trait hostility. **Emerging evidence suggests that low RSA and excessive RSA reactivity [...] are downstream peripheral markers of prefrontal cortex (PFC) dysfunction**" (*PubMed*, 24th December 2024).

Berthelot, Pierre Eugène Marcellin: The French biochemist **Marcellin Berthelot** ⁽¹⁸²⁷⁻¹⁹⁰⁷⁾ [[Wikipedia biography](#)] is noteworthy in the present context for his work in the second half of the 19th century synthesising organic compounds such as fats and sugars out of inorganic precursors. He is acclaimed nowadays as "one of the most famous chemists in the world".

Blood Sugar: See **routine bloods**.

Bruno, et al. (2013): [For the broader context see **omega-3 fatty acids** and **PUFA explanations of disease**.] On 1st January 2014^{sic} the journal *Faraday Discussions* published a paper by Bruno, *et al.* titled "**Interactions of drugs and amphiphiles with membranes: modulation of lipid bilayer elastic properties by changes in acyl chain unsaturation and protonation**" [[full text online](#)], examining how changes in acyl chain unsaturation, and head group charge and size, alter bilayer properties. This is a highly technical paper reflecting on the saturated-unsaturated question in general, and will not be further discussed here.

Calcium-Sparing Diuretics: See **diuretics**.

Callous and Uncaring (CU) [**As A Personality Trait Within Psychopathy**] [[Google AI briefing](#)]: CU is a personality trait within a cluster of like traits known by objective research to be more or less correlated with challenging behaviour. The trait can be quantified in subjects using the **Inventory of Callous Unemotional Traits (ICU)** [see the entry for **Cardinale, et al. (2019)**]. **FURTHER READING:** At time of writing ^[=23rd December 2024] there were 343 hits for <callousness> on *PubMed* - [check them out](#) - but none of these deal with the possible effects of diet on early development of the trait.

Carbonic Anhydrase Inhibitors: See **diuretics**.

Cardinale, Elise M. [[University biography](#)]: American biological psychologist specialising in "callous-unemotional traits and amygdala function as well as impaired cognitive control and associated atypical fronto-parietal circuitry". See, for example, **Cardinale, et al. (2019)**.

Cardinale, et al. (2019): On 1st July 2019 the journal *Psychological Medicine* published a paper by **Elise M. Cardinale** [see own entry], *et al.* titled "**Callous and uncaring traits are associated with reductions in amygdala volume**" [[full text online](#)], in which the size of the **amygdala** [see own entry **IMPORTANT PARALLEL NARRATIVE**] appeared to be predictive of (1) **externalising behaviour** [[Wikipedia briefing](#)], and (2) subjects' score on the **callous and unemotional (CU)** psychometric score [see own entry]. Here is an indicative clip from the *Abstract* ...

"The emergence of callous unemotional (CU) traits, and associated externalizing behaviors, is believed to reflect underlying dysfunction in the amygdala. Studies of adults with CU traits or psychopathy have linked characteristic patterns of amygdala dysfunction to reduced amygdala volume, but studies in youths have not thus far found evidence of similar amygdala volume reductions. The current study examined the association between CU traits and amygdala volume by modeling CU traits and externalizing behavior as independent continuous variables, and explored the relative contributions of callous, uncaring, and unemotional traits. [...] CU traits and externalizing behavior problems were assessed in 148 youths using the **Inventory of Callous Unemotional Traits (ICU)** [[Addiction Research Center briefing](#)] and the **Child Behavior Checklist (CBCL)** [[APA briefing](#)]. For a subset of participants (n = 93), high-resolution T1-weighted images were collected and volume estimates for the amygdala were extracted. Results.—Analyses revealed that CU traits were associated with increased externalizing behaviors and decreased bilateral amygdala volume. [...] These findings provide evidence that callous-uncaring traits account for reduced amygdala volume among youths with conduct problems" (*PubMed*, 24th December 2024).

Cell Death, Types Of: [INDEXING NODE] [read firstly the entry for **cell membrane structure and function** **ESSENTIAL PRIOR UNDERSTANDING**.] Here is a cluster of entries which, taken together, explain the various ways in which life comes to an end at the level of individual cells, and which are therefore fundamental to a proper understanding of the grosser system degradation seen in diseases and ageing (in narrative order, with *PubMed* hit counts ^{as at 1st December 2024} parenthesised) ...

Necrosis [[Wikipedia briefing](#); *PubMed* #715k since 1786]: Ancient medical term for areas of macroscopic tissue death as seen clinically in such conditions as frost-bite, gangrene, type 2 diabetes, etc.

Programmed Cell Death [[Wikipedia briefing](#); *PubMed* #47k since 1965]: Term coined by **Lockshin and Williams (1965)** [[full text online \(paywalled\)](#)] to describe the routine processes of EITHER (1) deliberately pruning out unwanted cells in an embryo, so as to guide subsequent foetal development, OR ELSE (2) detecting and recycling functionally faulty cells thereafter.

Apoptosis [[Wikipedia briefing](#); *PubMed* #582k since 1947]: [Sometimes *Type I cell death*] Standard descriptor for the routine weeding out of functionally faulty cells. Not *per se* a bad thing.

Autophagy [[Wikipedia briefing](#); *PubMed* #92k since 1963]: [Sometimes *Type II cell death*] Standard descriptor for the detection and triggered apoptosis of mildly faulty cells in conditions of protein deficiency. **This term is therefore frequently seen in the dietary advice industry.** Again not *per se* a bad thing.

Ferroptosis [[Wikipedia briefing](#); *PubMed* #15k since 2002]: See own entry.

Oxytosis [no separate briefing; *PubMed* #15k since 2001]: Alternative earlier name for **ferroptosis**.

Oxidative Stress [[Wikipedia briefing](#); *PubMed* #334k since 1970]: See own entry.

Necroptosis [[Wikipedia briefing](#); *PubMed* #7k since 2005]: The suggestion that cells can "commit suicide" by programmed necrosis as part of the immune system's response to a viral infection (thus denying the virus in question the environment it was seeking to replicate itself).

Channel Blockers: [CLASS INTRODUCTION] [See firstly **metabolic pumping**.] **Channel Blockers** [[Wikipedia briefing](#)] are a class of pharmaceutical capable of mechanically or metabolically impairing the ability of a **lipid bilayer membrane** to utilise various of its molecular transport mechanisms, thereby modulating the particular physiological processes normally

supported by said mechanisms. Channel blockers are thus widely prescribed EITHER to down-tune suspected pathological processes OR ELSE (by inhibiting an inhibitory action) to up-tune an underactive healthy one. See next (one by one) **calcium-channel blockers (CCBs)**, **potassium-channel blockers**, and **sodium-channel blockers**.

Chelation: [Adj. *chelate*; subst. *chelant*] **Chelation** [Wikipedia briefing] is a chemical reaction in which one of the ligands is an previously unbound metallic **cation**. The term was coined by **Morgan and Drew (1920)** [full text online] to describe the crabclaw-like grasping of inorganic metal ions by organic anions (specifically on that occasion, acetylacetonates) to form "ring structures" (p1457). Such reactions are therefore of interest whenever a particular metal (including, but not just, "heavy metals" such as mercury) needs to be moved from one place to another, as in the large-scale detoxification processes seen in industry or the much smaller-scale detoxification therapies used in the practice of medicine. In industry, chelation is widely applied, for example when detoxifying polluted terrain or bodies of water; also in desalination, fractionation of mixed metal sludges, decontaminating radionucleotides, and so on ...

[YouTube typical industrial chelation](#) (18 mins.)

We have dealt separately with the medical applications in the entry for **chelation therapy**, which see.

Chelation Therapy: [See firstly **chelation**.] **Chelation Therapy** [Wikipedia briefing] is a medical intervention in which a chelating agent is given in the hope that it will bind with a pathological excess of free metallic ions (following a heavy metal poisoning, say), thereby mitigating their effects.

[YouTube tutorial \(heavy metal poisoning\)](#) (4 mins.)

Chloroplasts: See **endosymbiosis**.

Chromoplasts: See **plastids**.

Citric Acid Cycle: See **Krebs cycle**.

Comprehensive Metabolic Panel (CMP) [Wikipedia briefing]: [See firstly **laboratory biomarkers**] The name given to the particular cluster of **routine bloods** laboratory biomarkers taken as standard for everyday medical decision making, that is to say, as the best compromise between complexity, practicality, and expense on the one hand, and diagnostic value on the other. See also **liver function tests (LFTs)** and compare **routine urines**.

Continuous Glucose Monitor (CGM): See **routine bloods**.

Corsetto, et al. (2012): [For the broader context see **omega-3 fatty acids**, **lipid rafts**, and **PUFA explanations of disease**.] On 1st September 2012 the journal *Cell Biochemistry and Biophysics* published a paper by **Corsetto, et al.** titled "**Chemical-physical changes in cell membrane microdomains of breast cancer cells after omega-3 PUFA incorporation**" [full text online], in which a possible association between dietary **DHA and EPA** levels and the incidence of breast cancer is discussed. The specific findings are as follows ...

"While EPA may contribute to cell apoptosis mainly through decrease of AA concentration in **lipid raft** phospholipids, DHA may change the biophysical properties of lipid rafts decreasing the content of cholesterol and probably the distribution of key proteins."

Crisi, et al. (2024): [See firstly **PUFA explanations of disease**.] On 29th July 2024 the journal *PLoS One* published a paper by **Paolo E. Crisi, et al.** titled "**Evaluation of the fatty acid-based erythrocyte membrane in cats with food responsive enteropathy [etc.]**" [full text online], presenting data on the lipid composition of the membranes of red blood cells drawn from cats suffering from a variety of digestive disorders, compared to healthy control animals. Here is an indicative clip from the piece, with the key finding highlighted **thus** (note especially the term "lipid imbalance in the closing sentence) ...

"Feline chronic enteropathies (FCE), include food-responsive-enteropathy (FRE), inflammatory bowel disease (IBD), and low-grade intestinal T-cell lymphoma (LGITL), and are common causes of chronic gastrointestinal signs in cats. [...] Assessing the fatty acid (FA) profile of red blood cell (RBC) membranes offers a valuable method for evaluating the quantity and quality of structural and functional molecular components in the membranes. Therefore, this study aimed to examine the FA composition of RBC membranes in FCE in comparison to healthy cats (HC). Gas-chromatography was used to quantitatively analyse a cluster of 11 FA, and based on these results, parameters of lipid homeostasis and enzyme activity indexes were calculated. [...] **In FCE cats, the values of docosapentaenoic acid (p = 0.0002) and docosahexaenoic acid (p = 0.0246), were significantly higher, resulting in an overall increase in ω-3 polyunsaturated fatty acids (PUFA) (p = 0.006), and that of linoleic acid (p = 0.0026) was significantly lower. Additionally, FCE cats exhibited**

[...] a decreased ω -6/ ω -3 ratio (p = 0.0019). [...] The non-invasive analysis of RBC membrane shows promise as a potential tool for gaining a better understanding of **lipid imbalances** in this disease."

The piece mentions the need for additional research into the lipid ratios in commercially available pet food.

CU: See **callous and uncaring (CU)**.

Cyanobacteria [[Wikipedia briefing](#)]: [See firstly **archaea** and **bacteria**.] A phylogenetically ancient phylum of bacteria capable of oxygenic **photosynthesis** and with niche ecology similar to **algae**. They are therefore particularly successful in environments low in ambient oxygen - indeed it has been suggested that their ability to recover oxygen from water was responsible for the early oxygenation of earth's atmosphere.

DDGS: See **Dried Distillers' Grains With Solubles (DDGS)**.

DeLany, et al. (2000): [See firstly **PUFA explanations of disease**.] On 1st October 2000 the *American Journal of Clinical Nutrition* published a paper by **DeLany, et al.** titled "**Differential oxidation of individual dietary fatty acids in humans**" [[full text online \(paywalled\)](#)], presenting data on fatty acid (FA) metabolism derived from the use of ^{13}C (that is to say, radioactive Carbon-13) as a tracer.

THE RESEARCH METHOD: In addition to controlling caloric intake in their subjects, the researchers set up trials with a range of different FAs containing ^{13}C at either the carboxyl or methyl end of the Carbon chain. Breath samples were then collected and measures taken of respiratory $^{13}\text{CO}_2$, in order to assess where, and over what time frame, the resulting metabolism had taken place.

Results of the study indicated that cumulative oxidation - the conversion of chained ^{13}C to expired $^{13}\text{CO}_2$ - over a 9 hour test period ranged from 41% of the dose for ingested laurates to only 13% for ingested stearates. Additionally, "of the 18-carbon fatty acids, linolenate was the most highly oxidised and linoleate appeared to be somewhat conserved". And additionally, ^{13}C recovery in breath from the methyl-labelled fatty acids was approximately 30% less than that from the carboxyl-labelled fatty acids".

Diagnostic Tests and Screening Procedures: These are measurements and measurement packages designed to assist during the assessment phase of patient management. The ability of a given test to detect someone who needs to be detected is known as its **sensitivity**. The ability to exclude people who need to be excluded is known as its **specificity**. The **positive predictive value** of a test is a measure of how many of those who have been detected as positive actually are positive, and its **negative predictive value** is a measure of how many of those who have been detected as negative actually are negative. Clinicians need to be aware of all four of these factors, and recognise that the qualities are to a large extent mutually exclusive. That is to say, a good test of one condition might be a bad test of something else. (There is actually a highly mathematical good reason for this, as summarised in the entry for **receiver operator characteristic (ROC)**.)

Diesters: See **esters**.

Diploid Cell Division: See **haploid vs. diploid cell division**.

Diuretics: [CLASS INTRODUCTION] **Diuretics** [[Wikipedia briefing](#)] are chemicals which *increase* the production of urine by the kidneys. Commonly known as "water tablets", they can be EITHER naturally occurring substances in our diet OR ELSE carefully targeted pharmaceuticals, and BOTH types are of particular interest in persons who are EITHER dehydrated (in which case they are to be avoided) OR pathologically retaining fluid (in which case they may be professionally prescribed). Under the heading of natural dietary diuretics we have ethanol, dandelion leaves, watermelon, asparagus, and many others. Pharmaceutical diuretics include ...

calcium-sparing diuretics [[Wikipedia briefing](#)]
carbonic anhydrase inhibitors [[Wikipedia briefing](#)]
loop diuretics [[Wikipedia briefing](#)]
osmotic diuretics [[Wikipedia briefing](#)]
potassium-sparing diuretics [[Wikipedia briefing](#)]
thiazides [see own entry]

[YouTube tutorial \(loop diuretics\)](#) (9 mins.)

See also and compare **antidiuretics**.

Dried Distillers' Grains With Solubles (DDGS) [[Wikipedia briefing](#) (we found this material **SERIOUSLY INCOMPLETE** when checked 27th December 2024)]: First mentioned in the *PubMed* medical literature by **Schabinger and Knodt (1948** [[PubMed](#)]), DDGS are noteworthy in the present context (a) as a profitable residue of the industrial distillation of corn mush to produce ethanol as a **biofuel** [[Wikipedia briefing](#)] ...

ASIDE: Grains contain husk, carbohydrates, fats, protein, minerals, and herbicide residues, but only the carbohydrates produce the alcohol - the rest is waste. It therefore makes good sense to recycle that waste as animal feed - **but only if the processing has not rendered it toxic.** And that is precisely the suspicion being investigated in the present entry.

... (b) for thereby becoming a major industry in its own right once the notion of sustainable biofuels took hold in the mid-2000s, but (c) for emerging even more recently as potentially the greatest careless mass poisoning of all time. **FURTHER READING:** We continue this story in the entry for **Ashley and Sarah Armstrong**.

******* THE PROBABLE KEY TO THE EVOLUTION OF COMPLEX LIFE ON EARTH *******

Endosymbiosis: [Alternatively *symbiogenesis*] **Endosymbiosis** [[Wikipedia briefing](#)] is likely the process by which one primitive organism evolved by incorporating another into its physical structure and thereby gaining access **NOT JUST to the other's immediate biochemistry BUT ALSO to the DNA by which an improved, compound organism might then be reproduced.** This is the received explanation for the structures and functions of the **eukaryotic cells** out of which all animal and plant life is constructed. The notion was first expounded by the German botanist **Andreas Schimper** [[Wikipedia biography](#)] in 1883 to explain the existence of **chloroplasts** [[Wikipedia briefing](#)] in plant cells¹. It was subsequently extended to animal cells as a unifying evolutionary principle in the early 20th century by the Russian biologist **Konstantin Mereschkowski** [[Wikipedia biography](#)], and hit the academic headlines again in 1967 with a paper by **Lynn Margulis** [[Wikipedia biography](#)] titled "On the origin of mitosing cells" [[Abstract online \(as L. Sagan\)](#)], by which all later refinements have been inspired.

¹This evolution is now believed to have taken place around 1600 MYA, and marks the point at which the plant and animal kingdoms went their different ways.

Eosinophil Count: See **routine bloods**.

Externalising Behaviour / Externalising Disorder: See **Cardinale, et al. (2019)**.

False Positive (FP) [in Clinical Decision Making]: [See firstly **diagnostic tests and screening procedures**.] See **positive predictive value (PPV)** and **specificity**.

False Negative (FN) [in Clinical Decision Making]: [See firstly **diagnostic tests and screening procedures**.] See **negative predictive value (PPV)** and **sensitivity**.

Fatty Acids (FA): [INDEXING NODE] Here is a cluster of entries which, taken together, explain and illustrate the structure and functions of the class of organic molecules known as **Fatty Acids** [[Wikipedia briefing](#)] (in concept cluster build order) .

Fatty Acids (FA), the basics

Saturated Fatty Acids (SFAs)

Monounsaturated Fatty Acids (MUFAs)

Omega-3 Fatty Acids

Omega-6 Fatty Acids

Omega-7 Fatty Acids

Omega-9 Fatty Acids

Omega-12 Fatty Acids

Polyunsaturated Fatty Acids (PUFAs)

PUFA explanations of disease

Fatty Acid Profile (of Cell Membranes): See **Crisi, et al. (2024)** and **Marchlewicz, et al. (2024)**.

"Fatty 15": [COMMERCIAL HEALTH SUPPLEMENT] See **C15 hypothesis**.

Felodipine: [Marketed as *Folpik*] **Felodipine** [[Wikipedia pharmacology](#)] is a dihydropyridine **calcium-channel blocker** used to relax blood vessels and thereby reduce blood pressure.

Ferroptosis: [Alternatively *oxytosis*] [For the broader context see firstly **cell death, types of**.] First discussed (but not explicitly named) in the early/mid 1980s by workers such as **Barry Halliwell** [[Wikipedia biography](#)] and **John Gutteridge** [bio needed] (see, for

example, **Halliwell and Gutteridge (1984)** [[full text online](#)]), **Ferroptosis** [[Wikipedia briefing](#)] is a form of metabolically triggered cell death characterised by runaway **peroxidation** [see own entry for the basic chemistry here] of the lipid membrane of the cell in question, apparently as the result of degradation of the normal glutathione-mediated antioxidant system. The term explicitly includes the root *ferro-* in order to reflect the part played by Fe⁺⁺ and Fe⁺⁺⁺ ions in that degradation [details on pp3-4 of the 1984 paper - Ed.]. **Tan, Schubert, and [Pamela] Mayer** [[Salk Institute biography](#)] (**2001**) [[full text online \(paywalled\)](#)] then suggested the term *oxytosis* to describe the process at work here, although **[Brent R.] Stockwell** [[Columbia University biography](#)] and **Dixon's** (2012) [[full text online \(as Dixon, et al.\)](#)] term *ferroptosis* is just as frequently seen nowadays. At time of writing [December 2024], ferroptosis is a hot research area [[check it out](#) if interested], with teams busily trying to chase down the precise enzyme mechanisms involved in the hope that it might allow cancerous cells to be targeted as part of metabolic therapy. In this context Stockwell and Dixon mention a glutathione blocker named **erastin** [[Wikipedia briefing](#)], thus ...

[YouTube tutorial on ferroptosis in cancer treatment](#) ^(6 mins.)

See also the series of entries for **Stephanie Venn-Watson**.

Flipping and Flippases: See **lipid bilayer membrane**.

"Fluid Mosaic" Model: The term "fluid mosaic" was coined by **Singer and Nicolson (1972)** [see own entry]) to emphasise the protean contractility of the prokaryote **lipid bilayer membrane**.

Free Radicals: See **ions vs. free radicals**.

Glycaemic Index (GI): See **routine bloods**.

Goldmann, et al. (2024): [For the broader context see the entry for **lipid rafts**.] On 16th October 2024 the journal *Cellular and Molecular Life Sciences* published a paper by **Goldmann, et al.** titled "**Alpha-hemolysin promotes internalization of Staphylococcus aureus into human lung epithelial cells via caveolin-1- and cholesterol-rich lipid rafts**" [[full text online](#)], in which lipid rafts were implicated in the entry of *Staph. aureus* into the airway epithelium during pneumonia. Thus ...

"Staphylococcus aureus is a pathogen associated with severe respiratory infections. The ability of *S. aureus* to internalize into lung epithelial cells complicates the treatment of respiratory infections caused by this bacterium. In the intracellular environment, *S. aureus* can avoid elimination by the immune system and the action of circulating antibiotics. Consequently, interfering with *S. aureus* internalization may represent a promising adjunctive therapeutic strategy to enhance the efficacy of conventional treatments. Here, we investigated the host-pathogen molecular interactions involved in *S. aureus* internalization into human lung epithelial cells. **Lipid raft-mediated endocytosis was identified as the main entry mechanism.** Thus, bacterial internalization was significantly reduced after the disruption of lipid rafts with methyl- β -cyclodextrin."

Gutteridge (1984): See **ferroptosis**.

Haematacrit: See **routine bloods**.

Haploid vs Diploid Cell Division: Deriving from the Greek word ἀπλόος [read as *app-low-oss*], "single", the term **haploid** is one of the two main levels of **Ploidy** [[Wikipedia briefing](#)] in genetics. The term was borrowed into German in the closing decades of the 19th century by the botanist-geneticist **Eduard Strasburger** [[Wikipedia biography](#)] to describe the set of chromosomes present in each parental **Gamete** [[Wikipedia briefing](#)] prior to their fusion into (in mammals, at least) a **Diploid** [[Wikipedia briefing](#)] **Zygote** [[Wikipedia briefing](#)]. The word then came across into English in translations of Strasburger's books and first appeared [per PubMed 5th December 2024] in the English-language journalised literature with **Bridges (1919)** [[full text online](#)].

Headgroup Size (of Membrane Phospholipids): See **Vo, et al. (2024)**.

Hyperglycaemia: See **routine bloods**.

Hypoglycaemia: See **routine bloods**.

Ikhlef, et al. (2021): On 20th November 2021 the journal *BMC Biology* published a paper by **Ikhlef, et al.** titled "**Functional analyses of phosphatidylserine/PI(4)P exchangers with diverse lipid species and membrane contexts reveal unanticipated rules on lipid transfer**" [[full text online WELL WORTH A LOOK](#)], looking at the mechanisms controlling the **phospholipid** make-up of cell membranes and suggesting "novel insights into PS/PI(4)P exchangers, by showing that their activity is highly dependent on whether their lipid ligands **are saturated or not** and indicating the extent to which they can regulate the acyl chain composition of the PM".

Instinct Repertoire: The panoply of unlearned behaviours which a species is capable of, as listed, for example, by the University of Wisconsin-Madison's comparative psychologist **Wally Welker** back in 1976 (and [reproduced in this companion resource](#) [SELDOM BETTERED]).

Ions: See **ions vs. free radicals**.

Karnovsky, et al. (1982): On 1st July 1982 *The Journal of Cell Biology* published a paper by **Karnovsky, et al.** titled "**The concept of lipid domains in membranes**" [[full text online](#)], in which the authors review research into lipid domains in the decade since **Singer and Nicolson (1972)** and suggest a significant upgrade to that earlier model. Here is the nub of their suggestion ...

"In this model both proteins and lipids are free to diffuse in the bilayer, implying a random organization of protein and lipid. However, experimental evidence in diverse types of membranes and for several protein entities indicates that **the lateral motion of most proteins is not determined primarily by free diffusion through a two-dimensional viscous fluid, but is constrained, probably by mechanisms such as interactions with cytoskeletal components.** We will here present our evidence that lipids may also have nonhomogeneity in their lateral distribution, i.e., the lipid may be organized in domains, and that such organizational heterogeneity may have functional as well as structural significance."

Knobbe and Stojanoska (2017): Detailed in **Knobbe on Seed Oils and Vision**.

Knobbe on Seed Oils and Vision: [See firstly **PUFA explanations of disease**.] We refer here to the work of ophthalmologist turned celebrity "public health advocate" **Chris A. Knobbe** [[homepage](#)] as set out formally in the (jointly with Suzanne J. Alexander) 2023 book "**The Ancestral Diet Revolution: How Vegetable Oils and Processed Foods Destroy Our Health - and How to Recover!**" [[Amazon](#)] as well as a number of supporting social media presentations. Both works build on arguments previously fielded in **Knobbe and Stojanoska's (2017)** paper titled "**The 'Displacing Foods of Modern Commerce' Are the Primary and Proximate Cause of Age-Related Macular Degeneration: A Unifying Singular Hypothesis**" [[full text online \(paywalled\)](#)], in which the case is made that "processed, nutrient-deficient and potentially toxic foods" may well be self-inflicting Humankind with the eye disease known as **age-related macular degeneration (AMD)** [[Wikipedia briefing](#)]. Here is an indicative clip from that paper ...

"Age-related macular degeneration (AMD) is the leading cause of irreversible vision loss and blindness in developed nations. [...] However, the aetiology of this disease remains unknown. [...] We sought to examine the hypothesis that consumption of the 'displacing foods of modern commerce,' which equate to processed, nutrient-deficient and potentially toxic foods, may be the primary and proximate cause of AMD. To evaluate this hypothesis, we ran correlative AMD prevalence data against well-known proxy markers of processed food consumption, namely, sugar and vegetable oils, in 25 nations. In twenty-one nations, published studies provided AMD prevalence data and in four Pacific Island nations, practicing ophthalmologists in the regions completed retrospective chart analyses to estimate AMD prevalence in their respective regions. To estimate AMD prevalence historically, an extensive review of published papers and ophthalmic literature was completed. This review indicates that, between the years 1851 and 1930, AMD was a medical rarity worldwide, which then rose modestly in prevalence in the 1930s in the U.S. and U.K, **finally elevating to epidemic proportions by 1975 in the U.S.** [...] Simultaneously, between approximately 1880 and 2009, processed, nutrient-deficient foods gradually supplanted and displaced whole, unprocessed, nutrient-dense foods in developed nations, such that by 2009, 63 percent of the American diet was made up of nutrient-deficient foods in the form of refined white flour, added sugars, vegetable oils, and artificially created trans fats. **The correlative data in 25 nations shows that increasing sugar and polyunsaturated vegetable oil consumption is invariably associated with new onset or rising prevalence of AMD, generally within about 30-40 years of the beginning of increasing consumption of these proxy marker processed food components.**"

... and here is a typical social media re-statement ...

[YouTube Knobbe making his case](#) (19 mins.)

"You can't manage what you can't measure" (Peter Drucker)

Laboratory Biomarkers [[Wikipedia briefing](#)]: [Variously *labwork, labs*] Biomarkers are (1) any laboratory assay which reflects more or less directly upon the health of an underlying physiological system, and hence (2) a priceless adjunct to clinical examination and case management. They can conveniently be divided into two types, namely routine and specialised, as follows ...

QUICKIE - ROUTINE LABS: These are upwards of a dozen tests which are cheap and relatively easy to carry out by properly trained staff. The systems most commonly targeted are (1) the heart and circulatory

system [see **routine blood tests** and **comprehensive metabolic panel (CMP)**], (2) the liver and hepatic system [see **liver function tests**], and (3) the kidneys [see **routine urine tests**]. Many assays are also available in scaled-down form as kits for bedside, health centre, or home usage. Among the best known of these are the **urine dipstick kits** [Wikipedia briefing], the **finger prick / "fingerstick" tests** [Wikipedia briefing], and the **continuous glucose monitor (CGM)** [Wikipedia briefing; [click here to review the marketplace for <continuous glucose monitors>](#)]. Diagnostic tests and screening programs use a wide variety of technical abbreviations, including **ULN** [= *upper limit of normal*], which indicates that a particular measure or related set thereof is at the high end of the normal range and requires re-checking shortly, and **SWT** [= *satisfaction with treatment*].

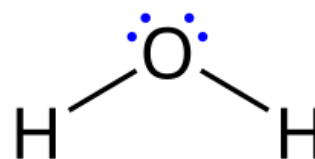
QUICKIE - SPECIALISED LABS: These are measures EITHER of general inflammation OR ELSE of specific pathology - see for example **C-reactive protein (CRP)** and **prostate-specific antigen (PSA)**, respectively. Such tests exist (or are being vigorously researched) in all types of disease. Most readers, for example, will have had personal experience of the **COVID lateral flow test** in the recent past, and many of the older ones (hopefully not on the same day) will have had to provide samples for **colorectal cancer screening** [Wikipedia briefing].

FURTHER READING: Test results should be interpreted with caution for they are never 100 per cent reliable in isolation. The generic problem of test interpretation and the setting of ULNs is explained in the entry for **diagnostic tests and screening procedures** [IMPORTANT], and the pivotal issues are then further discussed in the entries for **negative predictive value (NPV)**, **positive predictive value (PPV)**, **receiver operator characteristic (ROC)**, **sensitivity**, and **specificity** [ALL INTERLINKED AND TECHNICAL].

LCHF: See **low carbohydrate high fat (LCHF) diet**.

Lewis Dot System: [For the broader context see **atomic orbitals and electron domain geometry**.] The **Lewis Dot System** [Wikipedia briefing] is a diagramming convention designed to say more about a molecule's structure than the standard system of chemical formulae by displaying the geometric disposition of electrons not already tightly allocated to **polar covalent bonds** [USEFUL PARALLEL EXPLANATION]. Here is an example of the old and the new systems contrasted ...

EXAMPLE - THE WATER MOLECULE: It has been known since **Avogadro's** time [Wikipedia biography] that a given volume of oxygen gas will react more or less violently with *two such volumes* of hydrogen to produce an equal mass of water - so water contains two Hs, one O. This eminently replicable laboratory observation was then variously expressed in print as H₂O, with superscripted numeral as H²O, or (nowadays) with subscripted numeral as H₂O. Unfortunately, when the complexities of atomic orbitals and three-dimensional bond angles started to emerge in the early 20th century, the standard system was found wanting. Given that like charges repel each other, the stable configuration of a water molecule has four spare electrons (variously termed *non-bonding*, or "*lone pair*" electrons) pushing away from the four electrons bound (two each) into the two covalent H-O bonds and displacing those bonds in turn out of linear alignment. The Lewis dot system for this structure is as here shown (in fact, a further two electrons remain central to the oxygen atom and are NOT shown even in the Lewis system - explanation below) ...



The dot system was popularised by the Berkeley chemist **Gilbert N. Lewis** [Wikipedia biography] following a 1916 paper titled "**The atom and the molecule**" [full text online HISTORICALLY SIGNIFICANT PAPER]. Here - but with amended hyperlinking - is how the Wiki assesses the work ...

"In 1916, he published his classic paper on chemical bonding "*The Atom and the Molecule*", in which he formulated the idea of what would become known as the covalent bond, consisting of a shared pair of electrons, and he defined the term odd molecule (the modern term is free radical) when an electron is not shared. He included what became known as *Lewis dot structures* as well as the [earlier and now improved - Ed.] **cubical atom model** [Wikipedia briefing]. These ideas on chemical bonding were expanded upon by **Irving Langmuir** [Wikipedia biography] and became the inspiration for the studies on the nature of the chemical bond by **Linus Pauling** [Wikipedia biography]" (as at 9th November 2024).

... and here is how one of the best social media educators summarises the topic ...

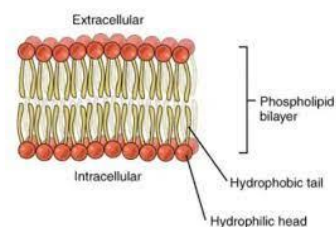
["Professor Dave" explains the Lewis dots](#) (5 mins.)

FURTHER READING: To take account of the two unaccounted-for electrons mentioned above, it is necessary to go further than the Lewis system and show the component orbitals - [check it out here](#).

Lin, et al. (2022): On 24th June 2022 the journal *Frontiers in Plant Science* published a paper by **Lin, et al.** titled "**Dynamic Changes in Membrane Lipid Metabolism and Antioxidant Defense During Soybean (*Glycine max* L. Merr.) Seed Aging**" [full text online], in which membrane lipid changes in plants during seed aging were found to affect seed longevity. Here is an indicative clip ...

"... the potential relationship between oxidative stress and membrane lipid metabolism was evaluated by using a non-targeted lipidomics approach during artificial aging of *Glycine max* L. Merr. Zhongdou No. 27 seeds. We determined changes in reactive oxygen species, malondialdehyde content, and membrane permeability and assessed antioxidant system activity. We found that decreased non-enzymatic antioxidant contents and catalase activity might lead to reactive oxygen species accumulation, resulting in higher electrolyte leakage and lipid peroxidation. The significantly decreased phospholipids and increased glycerolipids and lysophospholipids suggested that hydrolysis of phospholipids to form glycerolipids and lysophospholipids could be the primary pathway of membrane metabolism during seed aging."

Lipid Bilayer Membrane: [A.k.a. *phospholipid bilayer membrane*, *plasma membrane*, or *cell membrane*.] Lipid bilayers consist of a two-dimensional flat sheet of multiple millions of "head-upwards" **phospholipid** [Wikipedia briefing] **macromolecules**, laid out over a second sheet of exactly the same but facing the other way (that is to say, "head downwards"). Figure right is what the arrangement looks like in diagrammatic cross-section. Lipid Bilayers are fundamentally important to all complex life on earth because one of their basic properties is to be relatively impermeable. Unsurprisingly, therefore, they are used to encase BOTH biological **organelles** AND the **cells** containing those organelles, and it is from trillions of these cells - properly differentiated - that plants and animals (including us) are constructed. WE EXIST AS SOLID ENTITIES IN OTHER WORDS BECAUSE THE CONTENTS OF OUR CELLS ARE HELD IN PLACE BY THEIR ENVELOPING LIPID MEMBRANE. Lose that membrane and we are all just warm slush. For the biochemical detective work which took place between 1895 and 1935 to decipher the bilayer structure, [see this Wiki](#). The component phospholipid molecules are synthesised within the cell and therefore first migrate into the INNER layer, being subsequently "flipped" into the OUTER layer by enzymes known as **flippases** [Wikipedia briefing]. See also "**fluid mosaic**" model.



Lipid Domains: Dealt with in the entry for **lipid rafts and endocytosis**.

Lipid Peroxidation: [For the basic chemistry see the entry for **peroxidation**; for the basic cell biology see **lipid bilayer membrane**.] **Lipid peroxidation** [Wikipedia briefing] is a sequence of reactions in a cell's lipid membranes which serve to add a disruptive **hydroperoxyl group** [Wikipedia briefing] to a previously healthy lipid molecule, thereby NOT ONLY rendering that particular molecule dysfunctional in isolation, BUT THEREBY ALSO degrading - perhaps terminally - the viability of the membrane *or cell* in which the molecule in question happens to be situated ...

ASIDE: The points at which (1) the accumulation of dysfunctional molecules renders an *entire cell* dysfunctional, and (2) the accumulation of dysfunctional cells renders the *organism as a whole* dysfunctional, have yet to be established and are being actively researched - [click here](#) for some state-of-the-art thinking.

Lipid Peroxidation is noteworthy in the present context because it is perhaps the main way in which **oxidative stress** damages living tissue ...

Readers unfamiliar with the problems of <free radicals>, <oxidative stress>, and <reactive oxygen species> should see the separate entries before proceeding.

Recent research has focused on the effects of lipid peroxidation on ageing (see, for example, **Allowitz, et al. (2024 [full text online (paywalled)])**), in toxicology (**Chen, et al. (2025 [full text online (paywalled)])**), in food supply chain management (**Gallazzi, et al. (2025 [full text online (paywalled)])**), in dietary supplementation (**Joubert, et al. (2025 [full text online (paywalled)])**), and in the treatment of cancer (**Yang, et al. (2024 [full text online (paywalled)])**). **FURTHER READING:** For a recent perspective piece on this rapidly developing research area see **Zheng, et al.'s (2024) paper "Emerging mechanisms of lipid peroxidation in regulated cell death and its physiological implications"** [full text online].

Lipid Rafts and Endocytosis: [For the broader context see **cell membrane structure and function** and **PUFA explanations of disease**.] **Lipid rafts** [Wikipedia briefing] are comparatively small areas - often referred to as "**microdomains**" - of structural and functional specialisation on the outer leaflet of the otherwise homogenous lipid bilayer of a cell or organelle membrane. One important differentiating factor between a membrane and its rafts lies in their respective lipid compositions. Rafts, for example, contain more cholesterol than the surrounding bilayer, and are also richer in **sphingolipids** such as **sphingomyelin**. It is commonly presumed that these microdomains are areas of metabolically controlled **endocytosis**. Early research in this area tended to refer to such phenomena as **lipid domains** [Wikipedia briefing] and is helpfully summarised in papers by **Singer and Nicolson (1972)** and **Karnovsky, et al. (1982)**; the change to lipid *rafts* came in the late 1990s. Here are some indicative recent research reports (in publication date order) ...

Schuberth and Wedlich-Söldner (2015)

Tan, et al. (2018)

Ruan, et al. (2022)

Ruzzi, *et al.* (2024)
Goldmann, *et al.* (2024)

FURTHER READING: At time of writing [= November 2024] *PubMed* returns 1181 hits for the compound keyword <"lipid domains">, [which see](#), the earliest being in 1974, and 6966 hits for the compound keyword <"lipid rafts">, [which see](#), the earliest being in 1997 (both terms remain in use of late). For the summative textbook detail see **Thomas J. McIntosh's** (2008) "**Lipid Rafts**" [[Amazon](#)].

Liver Function Tests (LFTs) [[Wikipedia briefing](#)]: [INDEXING NODE] [A.k.a. *hepatic panel*] [More fully contextualised in the entries for **laboratory biomarkers** and **routine bloods**.] LFTs are that element of routine blood testing which reflects particularly on liver health. Here are two helpful public domain tutorials ...

[Beginner's YouTube tutorial on LFTs](#) (5 mins.)
[Further Detail](#) (27 mins.)

The constituent tests are as follows ...

Serum bilirubin level [[Wikipedia briefing](#)]
Serum total protein [[Wikipedia briefing](#)]
Serum albumin [[Wikipedia briefing](#)]
Serum globulin [[Wikipedia briefing](#)]
Serum alkaline phosphatase [[Wikipedia briefing](#)]
Serum ALT level [[Wikipedia briefing](#)]

Long COVID: Long COVID [[Wikipedia briefing](#)] is a cluster of common sequelae which emerge around twelve weeks [although different countries apply different cut-offs - Ed.] after a primary COVID infection and are capable not just of lasting a lifetime, but of potentially markedly shortening that lifetime. The most commonly seen complications are summarised by **Bangham (2024)** [[full text online](#)] as follows ...

"The picture is far from clear, partly because the symptoms can be so diverse. The most common symptom by a considerable margin is ongoing and intermittent fatigue, along with 'brain fog', memory problems or confusion. But there are at least 37 symptoms that have been identified as frequently occurring in Long Covid patients, and as many as 200 other symptoms in 10 different organ systems have been described in some people with the condition."

Here are some examples of the range of systems involved ...

Guedj, *et al.* (2025) [[full text online \(paywalled\)](#)] (on neurological and psychiatric complications)
Calabrese, *et al.* (2025) [[full text online \(paywalled\)](#)] (on rheumatological complications)
Menzies, *et al.* (2024) [[full text online \(paywalled\)](#)] (on the attendant anxiety and depression)

... and here are some studies into the role of diet in mitigating either the onset of the condition or its subsequent remediation ...

Wang, *et al.* (2024) [[full text online](#)] (in an older population)
Janko, *et al.* (2024) [[full text online \(paywalled\)](#)] (in a vegetarian community)
Haag, *et al.* (2024) [[full text online](#)] (intervention trial)

Social media gurus have also been active with their advice, but these sources need to be treated with caution and we shall not give any examples.

Loop Diuretics: See **diuretics**.

Lymphocyte Count: See **routine bloods**.

Mackie, *et al.* (1987): [See firstly **PUFA explanations of disease**.] In 1987 Volume 9(4) of the journal *Nutrition and Cancer* published a paper by **Mackie, *et al.*** titled "**Melanoma and dietary lipids**" [[full text online \(paywalled\)](#)], in which adipose tissue samples taken in 1984-1985 showed (1) "substantially higher" levels of **linoleic acid** than comparison samples taken ten years earlier, and (2) significantly higher **PUFA** levels in melanoma patients than in controls. Here, from the Abstract, are the key numbers and an early ominous suggestion ...

"Samples of subcutaneous adipose tissue were taken from 100 melanoma patients and 100 matched controls in Sydney in 1984-1985 and were analysed for constituent fatty acids. **The mean percentage of linoleic acid in the triglycerides of the subcutaneous adipose tissue (PLASAT) of these subjects was substantially higher than that in a similar group examined in 1975-1976.** In addition, **the percentage of polyunsaturated fatty acids was found to be higher in the melanoma patients than in the controls** (p less than 0.01), and there were significantly more controls than patients who had a low PLASAT (p less than 0.01). **Relevant literature**

is quoted and the suggestion is made that increased consumption of dietary polyunsaturates may have a contributory effect in the aetiology of melanoma."

MAOA Gene / MAO-A Enzyme: See **monoamine oxidases**.

Marchlewicz, et al. (2024): [See firstly **PUFA explanations of disease**.] On 7th June 2024 the journal *Nutrients* published a paper by **Mariola Marchlewicz, et al.** titled "**Fatty acid profile of erythrocyte membranes in patients with psoriasis**" [[full text online](#)], presenting data on the lipid composition of the membranes of red blood cells drawn from humans suffering from psoriasis at various points in their treatment. Here is an indicative clip from the piece, with the key finding highlighted **thus** ...

"Psoriasis is a chronic systemic disease with a multifaceted pathomechanism and immunological basis, with the presence of inflammatory skin lesions and joint ailments. Diseases accompanying psoriasis include metabolic and cardiovascular disorders. It has been suggested that inflammation is involved in the development of each of these conditions. The main objective of this study was to analyse the fatty acid profile, including polyunsaturated fatty acids, in the erythrocyte membranes of patients suffering from psoriasis. [...] All patients had their weight and height measured to assess their body mass index (BMI). After 3 months of treatment, biochemical parameters (ALT, AST, total cholesterol) and inflammatory markers (CRP) in the blood were assessed. In addition, the isolation of fatty acids (PUFAs, SFAs, MUFAs) from erythrocyte membranes and the qualitative and quantitative analysis of their profile using a gas chromatograph were carried out. **In patients with severe psoriasis requiring systemic treatment, an altered profile of fatty acids in erythrocyte membranes was found, including a significantly lower concentration of polyunsaturated fatty acids (omega-3), which have an anti-inflammatory effect; a significantly higher concentration of saturated fatty acids; and a decreased concentration of oleic acid (omega-9), compared to the results obtained in patients with less severe psoriasis receiving topical treatment.**"

Mayer and Schubert (2001): See **ferroptosis**.

Milk Products, Schindler On: On 1st November 2024 **Jesse Chappus's** YouTube channel puts out an interview with celebrity physician **Bill Schindler** [[homepage](#)] making a case for avoiding most readily available milk products, thus ...

[YouTube the piece here](#) ^(13 mins.)

WELL WORTH THE TIME AND EFFORT

The take away is that we would all be a lot healthier if we restricted our intake to high quality, traditionally made yoghurts and cheeses.

Monoamines / Monoamine Neurotransmitters [[Wikipedia briefing](#)]: [CLASS INTRODUCTION] As recognised by **CHEBI:63534** [[EBI database entry](#)], a monoamine is defined by the following common structure: A simple amine group at one end of a two-carbon **alkane** chain, with a carbon ring at the other, thus ...

[Amine Group]-CH₂-CH₂-[Ring Group]

There are four important monoamines in biological systems, namely (1) **dopamine**, (2) **norepinephrine**, (3) **serotonin**, and (4) **histamine**. All are important **neurotransmitters** ([see companion resource](#) for the expansion here).

Monoamine Oxidases A (MAO-A) [[Wikipedia briefing](#)] and **B (MAO-B)** [[Wikipedia briefing](#)]: [See firstly **monoamines / monoamine neurotransmitters**.] Enzymes involved in catalysing the oxidation of certain cellular amines, not least the neurotransmitters **dopamine** [see own entry] and **serotonin** [see own entry], in (1) the **brainstem** [see [companion resource](#)], and (2) the **hypothalamus** [see [companion resource](#)], **amygdala** [see [companion resource](#)], and **nucleus accumbens (N. Acc.)** [see [companion resource](#)] of the **limbic system** [see [companion resource](#)]. MAOs are therefore key regulators of the brain functions involving said transmitters, and so it follows that failures in MAO metabolism might be expected to produce parallel problems in observable behaviour. At time of writing [= 3rd January 2025] *PubMed* identifies over 25k papers for the keywords <"monoamine oxidase">. These go back to 1946, but the following lines of research seem to be particularly "hot" at present (note that data can be obtained from either controlled interventions or naturally occurring genetic anomalies) ...

Sblano, et al. (2025 [[full text online](#)]) - MAO inhibitors as chemotherapeutics in cancer

Halman, et al. (2025 [[full text online](#)]) - MAO inhibitors as psychedelics in psychiatry

Vahid, et al. (2024 [[full text online](#)]) - MAO's role in the aetiology of Alzheimer's disease

Ünsel-Bolat, et al. (2024 [[full text online \(paywalled\)](#)]) - MAOA gene mutation in **Brunner syndrome** [[Wikipedia briefing](#)], a rare genetic disorder associated with low IQ and severe behavioural disorders.

Monocyte Count: See **routine bloods**.

Monounsaturated Fatty Acids (MUFAs): See **fatty acids (FA), the basics.**

Muoio (2014): On 4th December 2014 the journal *Cell* published a paper by **D. M. Muoio** titled "**Metabolic inflexibility: When mitochondrial indecision leads to metabolic gridlock**" [\[full text online\]](#), in which he coined the term "metabolic gridlock" to describe a degraded ability of cells to switch quickly and appropriately between processing glucose and fats as demand or availability fluctuates. Here is an indicative clip from the piece, with the key finding highlighted **thus** ...

"Normal energy metabolism is characterized by periodic shifts in glucose and fat oxidation, as the mitochondrial machinery responsible for carbon combustion switches freely between alternative fuels according to physiological and nutritional circumstances. These transitions in fuel choice are orchestrated by an intricate network of metabolic and cell signalling events that enable exquisite crosstalk and cooperation between competing substrates to maintain energy and glucose homeostasis. By contrast, obesity-related cardiometabolic diseases are increasingly recognized as disorders of metabolic inflexibility, in which **nutrient overload and heightened substrate competition result in mitochondrial indecision, impaired fuel switching, and energy dysregulation.**"

Necroptosis: See **cell death, types of.**

Necrosis: See **cell death, types of.**

Negative Predictive Value (NPV): [See firstly **diagnostic tests and screening procedures.**] A test's NPV is a measure of how good that test is at detecting **true negatives** when all its decision negatives are considered. It is calculated by substituting empirical observations into the formula = $TN / (TN + FN)$. When NPV is high it indicates that the false negative problem is under control.

Neutrophil Count: See **routine bloods.**

Noakes Diet: See **low carbohydrate high fat (LCHF) diet.**

Noakes, Timothy David: South African sports scientist **Tim Noakes** [\[Wikipedia biography\]](#) is noteworthy in the present context (a) for joining the University of Cape Town in 1980 and thereafter figureheading the rise of sports science as an academic specialism, (b) for controversially being one of the first bioscientists to advocate (and personally practise) a **low carbohydrate high fat (LCHF) diet** [see own entry **ESSENTIAL CONTEXT**], (c) for promoting his ideas into the social media revolution of the early 21st century, and (d) for bringing those ideas up to date in an interview 10th January 2025 [see next entry]. **FURTHER READING:** At time of writing [= 12th January 2025] Prof. Noakes is credited with an impressive 537 *PubMed* publications - [check them out](#).

Noakes, Tim (Interview With Thomas DeLauer): [Continued from preceding entry.] [For the broader context see **PUFA explanations of disease ESSENTIAL PRIOR UNDERSTANDING.**] On 10th January 2025 one of the elder statesmen of the **low carbohydrate high fat (LCHF) diet** movement, Professor **Tim Noakes** [see own entry] was interviewed to camera by health sciences blogger **Thomas DeLauer** [\[YouTube homepage RECOMMENDED\]](#). His latest position was that while excess carbohydrate consumption was bad enough, it was "just as important" to avoid consuming PUFA contaminated foods. He was concerned that this latter risk had for whatever reason escaped attention, but that there was a compelling parallelism between the rise in PUFA consumption over the past 68 years and the otherwise unexplained rise of diseases like obesity and Type 2 diabetes.

[YouTube the full piece here](#) ^(11 mins.)
COMPULSORY VIEWING

Non HDL Cholesterol: See **serum lipids.**

Nucleated Red Blood Cell Count: See **routine bloods.**

Omega-3 Fatty Acids: See **fatty acids (FA), the basics.**

Omega-6 Fatty Acids: See **fatty acids (FA), the basics.**

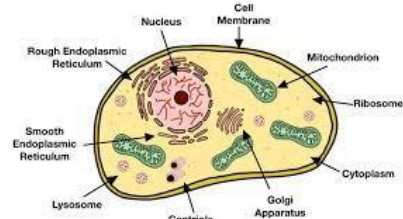
Omega-7 Fatty Acids: See **fatty acids (FA), the basics.**

Omega-9 Fatty Acids: See **fatty acids (FA), the basics.**

Omega-12 Fatty Acids: See **fatty acids(FA), the basics.**

Omeprazole: See **proton pump inhibitors (PPIs)**.

Organelle: An organelle is an agglomeration of organic **macromolecules** which have proven themselves so useful at feeding off each other's biochemistries that by keeping them together they become greater than the sum of their parts (albeit not yet complex enough to constitute a fully independent life form). Organelles are therefore routinely incorporated into larger, more competent, structures such as **eukaryotic cells**, and then in turn into whatever organism owns the organ owning the organelle. A typical organelle is the **mitochondrion** [Wikipedia briefing], which is in effect one of the cell's "power plants". Figure right is an image showing four such mitochondria (green), along with divers other organelles, inside a typical eukaryotic cell. Note that there are **lipid bilayers** around the organelles, *and then another* encompassing the cell itself. Note also that with mitochondria, the inner layer is actually considerably larger than the outer, causing it to become concertinad and giving it its characteristic inner appearance [see enlarged image here].



Osmotic Diuretics: See **diuretics**.

Oxidised Linoleic Acid Metabolites (OXLAMS) [no convenient briefing, but see [da Costa Souza, et al. \(2023\)](#)]: Oxidation products of **linoleic acid**, first appearing in the *PubMed* medical literature in 2012 and believed by some to be a major cause of **oxidative stress** [see own entry **IMPORTANT PARALLEL NARRATIVE**] if ingested. See, for example, the work of **Ashley Armstrong**.

OXLAMS: See **oxidised linoleic acid metabolites (OXLAMS)**.

Oxytosis: See **ferroptosis**.

Peroxidation [Wikipedia briefing]: Peroxidation is the inorganic chemical process by which a molecule's -OH radical is replaced by an $-O_2H$. The simplest example is that of the peroxidation of water (H_2O , structured as HOH) to give hydrogen peroxide (H_2O_2 , structured as $HOOH$), thus ...

[YouTube basic molecular structure](#) (4 mins.)

Peroxides tend to revert spontaneously to their original, thus releasing the "spare" oxygen atom. This spontaneous breakdown can be encouraged by suitable catalysts, and produces nascent oxygen and a lot of heat. As a result, hydrogen peroxide was once used in high-performance-per-unit-cost rockets or turbines, EITHER alone (when the heat alone is sufficient to turn the water into steam) OR ELSE as a conventional oxidant ...

[YouTube hydrogen peroxide in WW2 rocketry](#) (14 mins.)

In the present context we are concerned only with the adverse effects of peroxidation on the phospholipids making up cellular membranes, both internal and external - see the entry for **lipid peroxidation**.

Phospholipid Bilayer Membrane: See **Lipid Bilayer Membrane**.

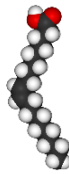
Phospholipid Packing in Biological Membranes: [For the broader context see **cell membrane structure and function** and **PUFA explanations of disease**.] Interest has been growing of late in the factors influencing the assembly of nascent **lipoprotein** molecules into their final **bilayer membranes**. The assembly process is straightforward enough when all the molecules concerned are homogenous - that is to say, with identical header units and straight chain alkane tails of equal length - because the class-defining electrostatic profile of such molecules acts so as to pack them tidily together in **flipped** pairs into their final bilayered sheet. Here is the Wikipedia schematic diagram of just one of these molecules ...



... and here is how clusters of them pack tidily together, like well-trained soldiers in an honour guard ...

[YouTube 252 neatly packed human phospholipids](#) ☺

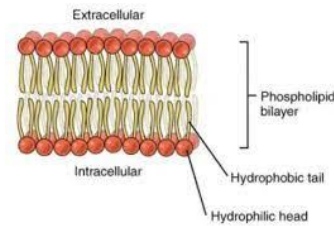
Things go downhill, however, when some of the straight chain alkane tails are replaced with **alkenes**, that is to say, alkanes with one or more $C=C$ double bonds - **BECAUSE THESE ARE NOT STRAIGHT AND ACCORDINGLY DO NOT STACK TIDILY**. These are the famous **unsaturated fatty acids**. Here is the Wikipedia schematic diagram of just one of these molecules (specifically, the single-kinked **oleic acid**) ...



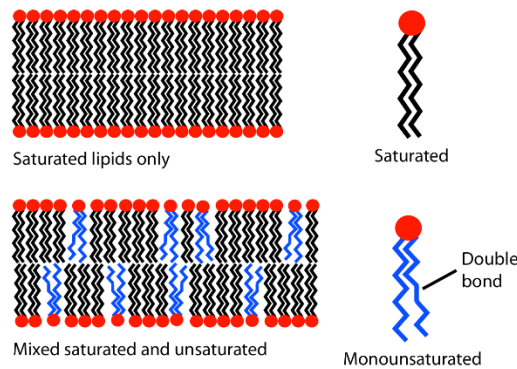
... and here (unless properly managed) is how these make for a veritable parade-ground disaster ...

[YouTube awkward squad phospholipids](#) ☺

Neatly packed membranes are shown in textbook graphics such as this one (by convention, the outer leaflet of the cell or organelle concerned is shown at the top) ...



... and the poorly packed - **and potentially dysfunctional** - ones look like this (lower diagram) [Wikipedia credits this graphic to one MDougM, public domain; we have been unable to locate a graphic showing the problems with two or more double bonds - Ed.] ...



ASIDE: Cognate minor blemishes of this sort in *inorganic* crystallography are referred to as [Taylor's] **dislocations** [Wikipedia briefing and images].

Here is why it all matters: **It is strongly suspected (1) that most disease processes result at least in part from membrane dysfunctions, and (2) that the dysfunctions result at least in part from imbalances in nutritional intake of fatty acids.** Every other word in the present resource is concerned in one way or another with these two issues.

FURTHER READING: The first mass-marketplace airing of the above ideas seems to have been in Chapters 3 thru 10 of Udo Erasmus' (1986/1993) "**Fats that Heal, Fats that Kill**" [Amazon **STILL A GOOD STARTING POINT**]. Those ready for the cutting edge of research may go straight to works such as Jason Hernandez' (2015) "**Lecithins and Phospholipids**" [Amazon], complemented by recent journalised material (at time of writing [= October 2024] PubMed returns fully 68 hits for the compound keyword <"**phospholipid packing**">, [which see](#)). See also, and compare, the entry for Vo, *et al.* (2024).

Plastids [Wikipedia briefing]: The group name for the various forms of synthesising **organelle** found in the **cytoplasm** of plant cells, including **chloroplasts** (photosynthesis) and **chromoplasts** [Wikipedia briefing] (pigment synthesis). All are believed to have derived ancestrally from the **endosymbiosis** of useful **cyanobacteria**.

Platelet Count: See **routine bloods**.

Ploidy: See **haploid vs. diploid cell division**.

Polysaccharides: See **routine bloods**.

Polyunsaturated Fatty Acids (PUFAs): See **fatty acids (FA), the basics**.

Positive Predictive Value (PPV): [See firstly [diagnostic tests and screening procedures](#).] A test's PPV is a measure of how good that test is at detecting **true positives** when all its decision positives are considered. It is calculated by substituting empirical observations into the formula = $TP / (TP + FP)$. When PPV is high it indicates that the false positive problem is under control.

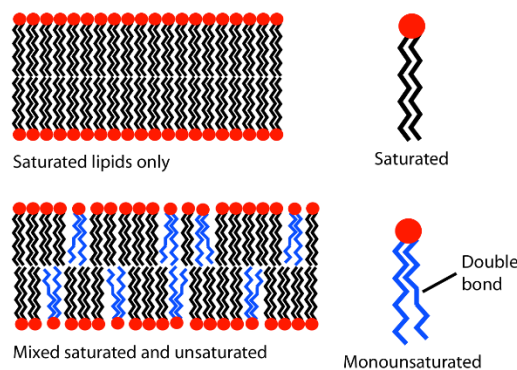
Potassium-Sparing Diuretics: See [diuretics](#).

Programmed Cell Death: See [cell death, types of](#).

Proton Pump: Follow the link in the entry for [physiological psychology](#) [**IMPORTANT - POSSIBLY THE EARLIEST LIFE-METABOLIC PROCESS TO HAVE EVOLVED**].

Proton Pump Inhibitors (PPIs): [CLASS INTRODUCTION] [See [channel blockers](#) for the general context and [proton pump](#) for the specifics.] **PPIs** [[Wikipedia briefing](#)] are a class of medication designed to suppress a carefully dosage-calculated proportion of the body's proton pump channels to therapeutic effect. PPIs were developed in the mid-1980s to inhibit stomach acid production and thereby to relieve acid reflux and similar problems [in chemistry, remember, acidity is ultimately a matter of proton density - Ed.]. **Omeprazole** [[Wikipedia briefing](#)] is one of the leading marketplace brands.

PUFA Explanations of Disease: We include under this heading any explanation of disease aetiology based upon the argument (1) that the ultimate pathology for the disease in question is a degradation (a) of the external **lipid bilayer membrane** of the body's cells (and/or (b) of the membranes of the **organelles** within those cells), caused by (2) dislocation of the neatly ordered sheets of phospholipid molecules making up those membranes, caused in turn by (3) levels of **polyunsaturated fatty acids (PUFAs)** never seen in any species in evolutionary history prior to the early 19th century, by virtue of the fact that those PUFA molecules are naturally kinked at the point of their C=C double bonds and therefore fail to fall neatly into place alongside their fully saturated (and unkinked) neighbours. Here, from the Wiki ^{8th October 2024} on [lipid bilayers](#), is an explanatory graphic showing both a normal bilayer (upper) and a mono-dislocated one (lower) [Wikipedia credits the graphic to one *MDougM*, public domain; we have been unable to locate a graphic showing the problems with two or more double bonds - Ed.] ...



Rawicz, et al. (2000): [See firstly [PUFA explanations of disease](#).] On 1st July 2000 the *Biophysical Journal* published a paper by **Rawicz, et al.** titled "**Effect of chain length and unsaturation on elasticity of lipid bilayers**" [[full text online](#)], presenting data on lipid membrane mechanics using synthesised lipids *in vitro* ...

THE RESEARCH METHOD: This research was carried out using a micropipette to deform focal areas of laboratory-synthesised specimens of lipid bilayers, measuring their "mechanical properties" in resisting said deformation. Measurements were repeated for "fluid diacyl phosphatidylcholine (PC) bilayers with chain lengths of 13 ± 22 carbons and a wide range of unsaturation (one, two, four, or six double bonds per lipid)."

Here is the research question ...

"Most phospholipid acyl chains in animal cell membranes are saturated (only C-C bonds) or monounsaturated (one C=C bond) hydrocarbon polymers. However, it is surprising that membranes rich in polyunsaturated (multiple methylene-interrupted C=C bonds) lipids are found in certain animal tissues (like the brain, for instance), and the lengths of unsaturated lipid chains vary significantly. An obvious question to be asked is, **how do hydrocarbon chain unsaturation and length affect membrane material properties important to the function and survival of cells?**"

... and here is what they observed ...

"Here we report results for equilibrium properties - elastic area and bending moduli. In a companion article (Olbrich *et al.*, 2000), we present results for dynamic properties - rupture strength (lysis tension) and water permeability - for the diC18 lipids with one to six cis double bonds. **In both studies, major effects of unsaturation were found to occur when two or more cis double bonds punctuated by saturated bonds (CAC-CAC) appear in one or both chains. In the case of elasticity, the surprising outcome is that this type of poly-cis unsaturation leads to a precipitous reduction in the bending stiffness of the bilayer, which is accompanied by a prominent reduction in thickness**, whereas neither chain length nor unsaturation significantly affects lateral area compressibility."

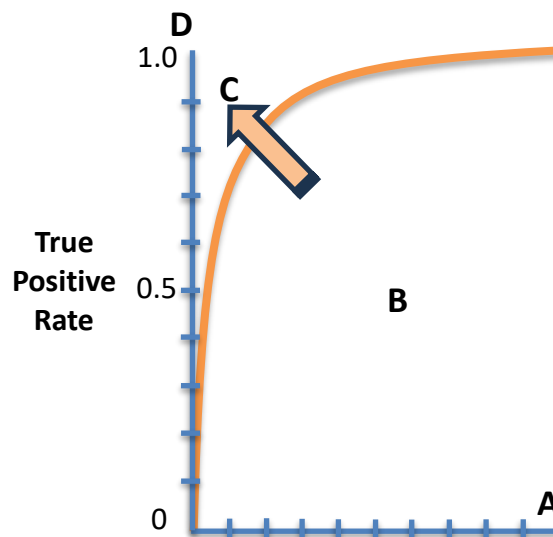
Receiver Operator Characteristic (ROC) [Wikipedia briefing]: [See firstly **diagnostic tests and screening procedures** (especially the need to balance the *sensitivity and specificity of a test*).] In the present context, the **receiver operator characteristic** of any decision making hot seat is its ability successfully to detect a target condition in a single diagnostic test without raising any false alarms (that is to say, in the technical jargon pertaining, the ability to report all **condition positives** as **true positives**, without raising any **false positives**). **UNFORTUNATELY, WITH THE MAJORITY OF TARGET CONDITIONS (INCLUDING - AND THIS IS THE POINT OF THE ENTRY - THE PRESENCE OR ABSENCE OF DISEASE) TOTAL PERFECTION IS NOT POSSIBLE.** This is why ...

QUICKIE - SIGNAL DETECTION THEORY: The term *receiver operator characteristic* derives from retrospective analysis during the 1950s of operator performance with WW2 military signal detection systems such as radar and ASDIC. Operators of these systems typically sat for hours on end, staring at some top secret gadget in case something significant - a lurking enemy submarine, say - should suddenly appear as a visual blip or an auditory ping. Thus ...

[YouTube the scenario \(anti-submarine\)](#) [26 mins. (pre-positioned at 6m30s)]

(Note as indicative the manual *echo-push* responses to each auditory ping at 6m57s)

Mistakes could be costly, but were - fatigue or simple loss of concentration *causa* - inevitable. With **false negatives**, for example, needles might have twitched just as you blinked, or pings might not have been quite loud enough, distant doors might have slammed, phones might have rung, and so on. Alternatively, the keener you were, the more likely you would be to err in the other direction and call a **false positive**. - reporting nothing as something. What the WW2 boffins did in their attempts to manage the problem (although their work would remain classified until the 1950s when it surfaced into post-war cognitive ergonomics as **Signal Detection Theory** [Wikipedia briefing]), was to plot success against failure on what they called the **ROC Curve** [Wikipedia briefing]. This is what the resulting "ROC Space" looked like ...



Key: The vertical (y) axis records the probability of a **true positive** judgement given a condition positive. The horizontal (x) axis records the probability of a **false positive** given a condition negative. Each point on the curve records the objective performance of a single operator, working under precisely parameterised conditions. If that operator detected 70% of all condition positives and mis-called only 10% of condition negatives, then s/he would be plotted at coordinates (0.1, 0.7). Operators could then EITHER be assessed against themselves in different conditions, OR ELSE against other operators. The curve and four of its zones are now further discussed ...

POINT A (coordinates 1.0, 0): This is the result of a test sequence which for whatever reason got every judgement wrong. It is so perfectly bad, in fact, that flipping a coin would have been a significant improvement.

POINT B (coordinates 0.5, 0.5): This is the result you would expect of an operator who performed at chance, like flipping a coin to see whether there was a submarine out there or not.

POINT C (coordinates 0.1, 0.9): This is the Goldilocks line [it is "just right"], that is to say, it is sensitive enough to be operationally worthwhile without inviting too many disruptive false alarms.

POINT D (coordinates 0, 1.0): This would be the result with an idealised operator, that is to say, one with perfect sensitivity. However, such perfection is EITHER (1) not sustainable in practice, OR (2) risks having been over-engineered (and therefore not being best overall value for money).

=====

The medical profession soon noted that clinicians engaged in diagnostic screening faced many the same problems. Like ASDIC operators, clinicians are pinging (carrying out their diagnostic tests) and then listening out for faint "echoes" (in the form of this or that suspicious test result). Moreover, just as with submarines, the available diagnostic systems often left much to be desired. The key skill, therefore, was to set the **upper limit of normal (ULN)** [see own entry] threshold at a sufficiently generous level. If you adjust the cut-off to a lower value, then it makes the test more **sensitive**, but only at the cost of having to put up with more **false positives**. If you set it higher then it makes the test more **specific**, but only at the cost of having to put up with more **false negatives**. This is often referred to as the point of "optimum compromise" between sensitivity and specificity - see, for example, **Hoo, et al. (2017 [full text online])**. **FURTHER READING:** This highly technical body of decision science is admirably covered by **Robert R. Mackie's** (1987) "**Vigilance: Theory, Operational Performance, and Physiological Correlates**" [Amazon] and **John A. Swets'** (1996) "**Signal Detection Theory and ROC Analysis**" [Amazon]. For a lifetime's publications at the heart of modern medical decision making theory see the work of **Douglas G. Altman** [Wikipedia biography] - [check it out](#). For a worked example of the calculations involved in converting clinical performance into ROC plots of this sort see **Altman and Bland (1994 [full text online (only half a page) VERY HELPFUL])**. The Excel spreadsheet software can be used to create ROC scatter plots if your data can be suitable formatted - [see Statology tutorial](#) [GREAT FUN].

ROC Curve: See receiver operator characteristic (ROC).

Routine Bloods: [Variously *blood tests, blood panel, bloodwork*, etc.] [See firstly **laboratory biomarkers**.] A battery of laboratory tests carried out on a **blood sample** [Wikipedia briefing] in order to assess general health and to screen for (or subsequently monitor the progress of) potentially serious anomalies, thus ...

Readers unfamiliar with the differences between "sugar" as an everyday commodity, "sugars" as a very large class of chemicals, and "sucrose" as a disaccharide built out of glucose and fructose molecules in equal measure, should see the entry for <sugar and sugars> before proceeding. In this entry we use the terms "table sugar" and "glucose" as therein precisely defined.

EXAMPLE - BLOOD GLUCOSE: To take probably the best known of the individual markers, your "blood glucose" is a titrated and chemically precise laboratory measure of the amount of glucose dissolved in your serum. **Since glucose is markedly pathogenic in all but the lowest concentrations, this measure should ideally be kept below 100 mg/dL** (= 5.6 mmol/L (or approx. 8 grams total, depending on body weight)), above which your managing physician will start to counsel lifestyle changes to prevent **hyperglycaemia** [Wikipedia briefing] ...

ASIDE: 100 mg/dL is the same as 1 g/L. This is what one gram of any crystalline sugar looks like in a typical teaspoon ...



Just for the experience, place this amount of table sugar in one litre of water, stir until dissolved, and sip [just tastes like water to us - Ed.].

Sustained hyperglycaemia is recognised as the single greatest avoidable (that is to say, elective dietary) cause of **insulin resistance (IR)** [see own entry **IMPORTANT PARALLEL NARRATIVE**], and IR is recognised in turn as the single greatest avoidable cause of **Type 2 Diabetes** [Wikipedia briefing]. **Hyperglycaemias higher than 600 mg/dL are life-threatening ...**

ASIDE: For a person with a total blood volume of 8 litres, a blood glucose of 600 mg/dL means a total circulatory load of 48 grams. This is what 48 grams of glucose looks like [but remember that in order to get 48 g. of glucose you are going to need twice that amount of table sugar - Ed.]. Again, just for the experience, place one eighth this amount of table sugar in one litre of water, stir until dissolved, and sip: this is 600 mg/dL and sweet enough to kill.



Low blood glucose can also be a problem. **Hypoglycaemias** [Wikipedia briefing] less than 50 mg/dL can be equally dangerous if the body has not been previously prepared - "fat adapted" - to switch to fat-burning instead. A more indicative measure - HbA1c - will often be encountered - details below. Scaled-down glucose testing kits are readily available for bedside, health centre, or home usage - see links at end of entry. As it happens, most dietary carbohydrates come in the form of "starchy" foods such as breads and pastas. These are predominantly **polysaccharides** [Wikipedia briefing] - polymer chains of many glucose molecules strung together - which are then broken down into their native glucose by digestive enzymes ...

ASIDE: Here are two 50 gram slices of pumpernickel (heavy rye bread). Taken together they contain roughly 40 grams of carbohydrate-derived glucose [there will be some variation across competing recipes - Ed.]. This is getting perilously close to the 48 grams potentially lethal dose mentioned above. Since this amount of glucose can easily be consumed at a single sitting, it is worth re-stating how one's body intervenes to handle the threat. The secret is that absent a **metabolic disorder** [see own entry **PARALLEL NARRATIVE**] **insulin** will be taking glucose *out of the bloodstream* as quickly as the digestive enzymes are putting it there. As a result, your blood glucose level fluctuates wildly by the minute, rising [the term "spiking" will often be seen in this context - Ed.] after a meal and then slowly dying away, at rates determined (on the supply side) by the **glycaemic index (GI)** [Wikipedia briefing] of the carbohydrates in that mean and (on the demand side) by consumption by muscles and other tissues. The aforementioned HbA1c assay is generally preferred because it is much less susceptible to fluctuation of this sort ...



QUICKIE - THE HbA1c TEST [Wikipedia briefing]: The HbA1c metric is predicated upon the following two facts: (1) that serum glucose is slowly absorbed into the membrane of the red blood cells, and (2) that red blood cells only survive for around three months. So if you test NOT THE SERUM but the separated off red blood cells you can compute a three-month average measure free of the fluctuations mentioned above.

The repertoire of blood tests considered as "routine" varies between commissioning health authorities and, indeed, internationally - [here, for example, is how America's Cleveland Clinic goes about things](#) [VERY HELPFUL]. That having been said, here are the pertinent sections of the present author's blood panel (South Wales, U.K.; 14-hour fasted) for 22nd February 2024 (note the borderline alert for *Serum ALT*) ...

HbA1c level - IFCC standardised	38 mmol/mol	< 48
(SWT) - Normal		
20-41: Non-diabetic range		
Serum lipids [see own entry]		
Serum cholesterol	6 mmol/L	
Serum triglycerides	1 mmol/L	< 2.0
Serum HDL cholesterol level	1.1 mmol/L	> 1.0
Non HDL cholesterol level	4.9 mmol/L	
Total cholesterol:HDL level	5.5 ratio	
Serum LDL cholesterol level	4.4 mmol/L	
! Liver function test [see own entry]		
(SWT) - a-satisfactory		
Serum bilirubin level	19 umol/L	< 21
Serum total protein	75 g/L	(60 - 80)
Serum albumin	41 g/L	(35 - 50)
Serum globulin	34 g/L	(22 - 43)
Serum alkaline phosphatase	72 u/L	(30 - 130)

! Serum ALT level	41 u/L	<41	
Serum electrolytes [see own entry] (SWT) - normal			
Serum sodium	138 mmol/L	(133 - 146)	
Serum potassium	4.5 mmol/L	(3.5 - 5.3)	
Serum creatinine	71 umol/L	(58 - 110)	
Full blood count - FBC [Wikipedia briefing]			
Total white cell count	4.4 10 ⁹ /L	(4.0 - 11.0)	[Wikipedia briefing]
Haemoglobin estimation	154 g/L	(130 - 180)	[Wikipedia briefing]
Platelet count	208 10 ⁹ /L	(150 - 400)	[Wikipedia briefing]
Red blood cell (RBC) count	4.98 10 ¹² /L	(4.50 - 6.00)	[Wikipedia briefing]
Haematocrit	0.45 L/L	(0.40 - 0.52)	[Wikipedia briefing]
[...]			
Neutrophil count	2 10 ⁹ /L	(1.7 - 7.5)	[Wikipedia briefing]
Lymphocyte count	1.4 10 ⁹ /L	(1.0 - 4.5)	[Wikipedia briefing]
Monocyte count	0.6 10 ⁹ /L	(0.2 - 0.8)	[Wikipedia briefing]
Eosinophil count	0.3 10 ⁹ /L	(0.0 - 0.4)	[Wikipedia briefing]
Basophil count	0 10 ⁹ /L	(0.0 - 0.1)	[Wikipedia briefing]
Nucleated red blood cell count	0 10 ⁹ /L		[Wikipedia briefing]

Here are some demonstration public domain tutorials on randomly selected topics ...

[YouTube tutorial on Albumin](#) (4 mins.)

[YouTube tutorial on Platelets](#) (6 mins.)

[YouTube tutorial on Nucleated RBCs](#) (2 mins.)

Ruan, et al. (2022): [For the broader context see the entry for **lipid rafts**.] On 22nd February 2022 the journal *Frontiers in Physiology* published a paper by **Ruan, et al.** titled "**N-(3-Oxododecanoyl) Homoserine Lactone Is a Generalizable Plasma Membrane Lipid-Ordered Domain Modifier**" [[full text online](#)], in which evidence is reported indicating lipid domain modifying powers for the lactone in question.

Ruzzi, et al. (2024): [For the broader context see the entry for **lipid rafts**.] On 11th October 2024 the journal *Cell Communication and Signaling* published a paper by **Ruzzi, et al.** titled "**Lipid rafts, caveolae, and epidermal growth factor receptor family: friends or foes?**" [[full text online](#)], suggesting ways in which lipid rafts might be therapeutically targeted against HER2-positive cancers.

Saladino on LDL Cholesterol: [See firstly **PUFA explanations of disease**.] We refer here to the work of celebrity physician **Paul ["Carnivore Diet"] Saladino** [[homepage](#)] as set out formally in the 2020 book "**The Carnivore Code**" [[Amazon](#)] and less formally in regular social media presentations. In common with many other cutting edge health advisers, his position on cholesterol is that the avoidance advice pushed by the health advisory committees for nigh on half a century is not just PLAIN WRONG but DANGEROUS. Here is a typical social media pitch ...

[YouTube Saladino on LDL cholesterol](#) (9 mins.)

Satisfaction With Treatment (SWT): See **laboratory biomarkers**.

Saturated Fatty Acids (SFAs): See **fatty acids (FA), the basics**.

Schaeffer, Edward M.: American urologist **Ted Schaeffer** [[university homepage](#)] is noteworthy in the present context (a) for holding senior departmental positions at both the Feinberg School of Medicine and Northwestern University, Chicago^{IL}, (b) as a world authority on prostate cancers, and (c) for a valuable series of educational presentations online ...

SAMPLE PRESENTATIONS: Here are three typical recent appearances online ...

[YouTube interview](#) (108 mins.)

[YouTube interview](#) (4 mins.)

[YouTube interview](#) (227 mins.)

FURTHER READING: At time of writing [= 20th December 2024] Prof. Schaeffer is credited with some 450 *PubMed* publications - [check them out](#).

Schuberth and Wedlich-Söldner (2015): [For the broader context see the entry for **lipid rafts**.] On 1st April 2015 the journal *Biochimica et Biophysica Acta* published a paper by **Schuberth and Wedlich-Söldner** titled "**Building a patchwork - The yeast plasma membrane as model to study lateral domain formation**" [[full text online](#)], in which the processes underlying the lateral segregation of proteins and lipids into "different functional domains" of the budding yeast cell

membrane are described. They conclude that these segregation processes comprise a "complex interplay between membrane transport pathways, macromolecular scaffolds, and protein–lipid interactions".

Sensitivity: [See firstly **diagnostic tests and screening procedures.**] This is a mathematically derived index of how good a test is at detecting **true positives**, that is to say, of how good that test is at detecting positives in a population of **condition positives**. It is calculated by substituting empirical observations into the formula $TP / (TP+FN)$. High sensitivity is called for in tests where **false negatives** are either expensive or downright dangerous. False negatives in medicine result in missed opportunities for treatment. In practice, however, highly **sensitive** tests often give high numbers of **false positives**, so in isolation they are less than perfect measures. The trade-off between sensitivity and the related **specificity** measure is explored in the entry for **receiver operator characteristic (ROC)**.

Serum Albumin: See **routine bloods**.

Serum Alkaline Phosphatase: See **routine bloods**.

Serum Bilirubin: See **routine bloods**.

Serum Cholesterol: See **serum lipids**.

Serum Globulin: See **routine bloods**.

Serum HDL Cholesterol: See **serum lipids**.

Serum LDL Cholesterol: See **serum lipids**.

Serum Total Protein: See **routine bloods**.

Serum Triglycerides: See **serum lipids**.

Seyfried on Cancer as a Metabolic Disease: We refer here to the work of research biochemist **Thomas N. Seyfried** [[Wikipedia biography](#)] as set out formally in some 200 peer-reviewed papers dating back to 1975 [[check them out](#)], the 2012 book "**Cancer as a Metabolic Disease**" [[Amazon](#)], and recently less formally in regular social media presentations, where he promotes an alternative theory of cancer aetiology and treatment ...

SEYFRIED'S METABOLIC THEORY OF CANCER: Seyfried's specific position is that cancers are not - as mainstream theory would have it - the result of self-destructive mutations to cell DNA, but rather the result of metabolic damage at mitochondrial level fuelled by excess blood glucose (details in the YouTube recommendations below). As such they are best mitigated by switching to a **ketogenic diet** and starving the tumours of their preferred fuel. In common with many other cutting edge health advisers, his position goes against the academic mainstream and risks - should it prove to be fundamentally incorrect - encouraging cancer sufferers to abandon a good treatment for a bad one. We shall post research updates here as and when they become available.

Here are some of Seyfried's typical social media pitches, interesting at worst, life-saving at best ...

[YouTube Seyfried on Cancer as a Metabolic Disease](#) (54 mins.)

[YouTube Seyfried Interview](#) (24 mins.)

[YouTube Seyfried on Dietary Intervention](#) (42 mins.)

Signal Detection Theory: See **receiver operator characteristic (ROC)**.

Singer and Nicolson (1972): [For the broader context see **cell membrane structure and function** and **lipid rafts and endocytosis.**] On 18th February 1972 the journal *Science* published a paper by **Singer and Nicolson** titled "**The fluid mosaic model of the structure of cell membranes**" [[abstract online](#)]. Here is a condensed version of the abstract ...

"A fluid mosaic model is presented for the gross organization and structure of the proteins and lipids of biological membranes. The model is consistent with the restrictions imposed by thermodynamics. In this model, the proteins that are integral to the membrane are a heterogeneous set of globular molecules, each arranged in an amphipathic structure, that is, with the ionic and highly polar groups protruding from the membrane into the aqueous phase, and the nonpolar groups largely buried in the hydrophobic interior of the membrane. These globular molecules are partially embedded in a matrix of phospholipid. The bulk of the phospholipid is organized as a discontinuous, fluid bilayer, although a small fraction of the lipid may interact specifically with the membrane proteins. The fluid mosaic structure is therefore formally analogous to a two-

dimensional oriented solution of integral proteins (or lipoproteins) in the viscous phospholipid bilayer solvent. Recent experiments with a wide variety of techniques and several different membrane systems are described, all of which are consistent with, and add much detail to, the fluid mosaic model. It therefore seems appropriate to suggest possible mechanisms for various membrane functions and membrane-mediated phenomena in the light of the model. As examples, experimentally testable mechanisms are suggested for cell surface changes in malignant transformation, and for cooperative effects exhibited in the interactions of membranes with some specific ligands. [...] These and related results strongly indicate that the bivalent antibodies produce an aggregation of the surface immunoglobulin molecules in the plane of the membrane, which can occur only if the immunoglobulin molecules are free to diffuse in the membrane. This aggregation then appears to trigger off the pinocytosis of the membrane components by some unknown mechanism. Such membrane transformations may be of crucial importance in the induction of an antibody response to an antigen, as well as in other processes of cell differentiation."

This paper is nowadays widely cited as pioneering thinking in the study of lipid domains and lipid rafts, and the approach is often referred to as the "*Singer-Nicolson fluid mosaic model*".

Singer-Nicolson Fluid Mosaic Model: Dealt with in the entry for **Singer and Nicolson (1972)**.

Specificity: [See firstly **diagnostic tests and screening procedures**.] A test's specificity is a measure of how good that test is at detecting negatives in a population of **condition negatives**. It is calculated by substituting empirical observations into the formula $TN / (TN + FP)$. High specificity is called for in tests where false positives are either expensive or downright dangerous. False positives in medicine result in inappropriate treatment or unnecessary referral. The trade-off between specificity and the related **sensitivity** measure is explored in the entry for **receiver operator characteristic (ROC)**.

Stockwell and Dixon (2012): See **ferroptosis**.

Suresh, et al. (2021): [For the broader context see **omega-3 fatty acids**, **lipid rafts**, and **PUFA explanations of disease**.] On 1st September 2021 *The Journal of Biological Chemistry* published a paper by **Suresh, et al.** titled "**Phospholipid exchange shows insulin receptor activity is supported by both the propensity to form wide bilayers and ordered raft domains**" [[full text online](#)], in which the authors cast some light on the phenomena of **lipid rafts** [see own entry].

Symbiogenesis: See **endosymbiosis**.

Szent-Györgyi-Krebs Cycle: See **Krebs cycle**.

Tail Length Asymmetry (of Membrane Phospholipids): See **Vo, et al. (2024)**.

Tan, et al. (2018): [For the broader context see the entry for **lipid rafts**.] On 1st July 2018 the journal *Molecular Neurobiology* published a paper by **Tan, et al.** titled "**Enriched Expression of Neutral Sphingomyelinase 2 in the Striatum is Essential for Regulation of Lipid Raft Content and Motor Coordination**" [[full text online](#)], in which it is suggested that the **sphingomyelinase** in question "is important for aggregation or clustering of proteins in lipid rafts".

TCA Cycle: See **Krebs cycle**.

Teixera, et al. (2019): [For the broader context see **omega-3 fatty acids**, **lipid rafts**, and **PUFA explanations of disease**.] On 29th May 2019 the journal *RSC Advances* published a paper by **Teixera, et al.** titled ""**Effects of lipid composition on membrane distribution and permeability of natural quinones**"" [[full text online](#)], in which simulations of subcellular chemistry highlight "the role of lipid **acyl chain** unsaturation for permeation and transversal diffusion of polar molecules across biological membranes".

Total:HDL Cholesterol Ratio: See **serum lipids**.

Triesters: See **esters**.

True Positive (TP) [in Clinical Decision Making]: [See firstly **diagnostic tests and screening procedures**.] See **positive predictive value (PPV)** and **sensitivity**.

True Negative (TN) [in Clinical Decision Making]: [See firstly **diagnostic tests and screening procedures**.] See **negative predictive value (PPV)** and **specificity**.

Type 2 Diabetes: See **routine bloods**.

Upper Limit of Normal (ULN): See **laboratory biomarkers**.

Valence Bond Theory: Dealt with in the entries for (beginners) **atomic bonding for non-chemists** and (advanced) **atomic orbitals and electron domain geometry**.

Venn-Watson, Stephanie: For general commentary and supporting YouTube link see the entry for **C15 hypothesis**. For specific publications see the three entries immediately below.

Venn-Watson, et al. (2020): [Venn-Watson selected publications, 1 of 3] On 7th April 2020 the journal *PLoS One* published a paper by **Stephanie Venn-Watson** [see own entry], *et al.* titled "**Modified fish diet shifted serum metabolome and alleviated chronic anemia in bottlenose dolphins (*Tursiops truncatus*): Potential role of odd-chain saturated fatty acids**" [full text online], in which the suggestion is made on the basis of 20 years research with dolphin physiology that adequate dietary C15:0 is a critical factor in controlling cell membrane viability. Here are the key points from the *PubMed* abstract ...

"Bottlenose dolphins (*Tursiops truncatus*) are long-lived mammals that can develop chronic aging-associated conditions similar to humans, including metabolic syndrome. Initial studies suggest that these conditions may be attenuated in dolphins using a modified fish diet. Serum metabolomics, fatty acid panels, and blood-based health indices were compared between 20 dolphins on a modified, 50% wild-type diet (50% mullet, 25% capelin, and 25% squid and/or herring) and 10 dolphins on a baseline diet (75% capelin and 25% squid and/or herring). Blood samples were collected at Months 0, 1, 3 and 6. Dolphins on the modified diet had lower insulin [...], lower cholesterol [...] and higher hematocrit [...] by Month 1 compared to controls. Dolphins with anemia [...] before placed on the modified diet had normal hemoglobin concentrations [...] by Month 3. [...] Among 25 prioritized lipids, 10 (40%) contained odd-chain saturated fatty acids (OCFAs); C15:0 was the highest-prioritized OCFAs. **Increased dietary intake of C15:0 [...] resulted in increased erythrocyte C15:0 concentrations [...], which independently predicted raised hemoglobin.** [...] While higher circulating OCFAs have been previously associated with lower risks of cardiometabolic diseases in humans, further studies are warranted to assess potential active roles of OCFAs, including C15:0, in attenuating anemia."

Venn-Watson and Butterworth (2022): [Venn-Watson selected publications, 2 of 3] On 26th May 2022 the journal *PLoS One* published a paper by **Venn-Watson and Butterworth** titled "**Broader and safer clinically-relevant activities of pentadecanoic acid compared to omega-3: Evaluation of an emerging essential fatty acid across twelve primary human cell-based disease systems**" [full text online], in which the authors continue to promote the health benefits of a diet rich in **pentadecanoic acid (C15:0)**. Here are the key points from the *PubMed* Abstract ...

"A growing body of evidence supports that pentadecanoic acid (C15:0), an odd-chain saturated fat found in butter, is an essential fatty acid that is necessary in the diet to support long-term metabolic and heart health. Here, dose dependent and clinically relevant cell-based activities of pure C15:0 (FA15TM) were compared to eicosapentaenoic acid (EPA), a leading omega-3 fatty acid, as well as to an additional 4,500 compounds. These studies included 148 clinically relevant biomarkers measured across 12 primary human cell systems, mimicking various disease states, that were treated with C15:0 at four different concentrations (1.9 to 50 µM) and compared to non-treated control systems. C15:0 was noncytotoxic at all concentrations and had dose dependent, broad anti-inflammatory and antiproliferative activities involving 36 biomarkers across 10 systems. In contrast, EPA was cytotoxic to four cell systems at 50 µM. [...] **In summary, C15:0 had dose-dependent and clinically relevant activities across numerous human cell-based systems that were broader and safer than EPA, and C15:0 activities paralleled common therapeutics for mood disorders, microbial infections, and cancer. These studies further support the emerging role of C15:0 as an essential fatty acid.**"

Venn-Watson (2024): [Venn-Watson selected publications, 3 of 3] On 23rd June 2024 the journal *Metabolites* published a paper by **Venn-Watson** titled "**The Cellular Stability Hypothesis: Evidence of Ferroptosis and Accelerated Aging-Associated Diseases as Newly Identified Nutritional Pentadecanoic Acid (C15:0) Deficiency Syndrome**" [full text online], in which the author summarises the case so far in favour of **pentadecanoic acid (C15:0)** as a longevity dietary supplement thanks to its ability to stabilise cell membranes and thereby to mitigate against ferroptosis. Here is the *PubMed* Abstract in full ...

"Ferroptosis is a newly discovered form of cell death caused by the peroxidation of fragile fatty acids in cell membranes, which combines with iron to increase reactive oxygen species and disable mitochondria. Ferroptosis has been linked to aging-related conditions, including type 2 diabetes, cardiovascular disease, and nonalcoholic fatty liver disease (NAFLD). Pentadecanoic acid (C15:0), an odd-chain saturated fat, is an essential fatty acid with the primary roles of stabilizing cell membranes and repairing mitochondrial function. By doing so, C15:0 reverses the underpinnings of ferroptosis. Under the proposed 'Cellular Stability Hypothesis', evidence is provided to show that cell membranes optimally need >0.4% to 0.64% C15:0 to support long-term health and longevity. A pathophysiology of a newly identified nutritional C15:0 deficiency syndrome ('Cellular Fragility Syndrome') is provided that demonstrates how C15:0 deficiencies (≤0.2% total circulating fatty acids) can increase susceptibilities to ferroptosis, dysmetabolic iron overload syndrome, type 2 diabetes, cardiovascular disease, and NAFLD. Further, evidence is provided that C15:0 supplementation

can reverse the described C15:0 deficiency syndrome, including the key components of ferroptosis. Given the declining dietary intake of C15:0, especially among younger generations, there is a need for extensive studies to understand the potential breadth of Cellular Fragility Syndrome across populations."

Vo, et al. (2024): On 1st August 2024 the *Journal of Chemical Physics* published a paper by **Vo, Murphy, Prabhu, and Stone** under the title "**Influence of phospholipid head and tail molecular structures on cell membrane mechanical response under tension**" [[full text online \(paywalled\)](#)]. This paper is noteworthy in the present context because it tangentially supports the **PUFA explanations of disease** [see own entry] by demonstrating that unsaturated phospholipids in a membrane rendered it less able to resist damage by mechanical deformation. Here is an indicative clip from the piece, with the key finding highlighted **thus** ...

"Biological cell membranes are primarily comprised of a diverse lipid bilayer with multiple phospholipid (lipid) types, each of which is comprised of a hydrophilic headgroup and two hydrophobic hydrocarbon tails. The lipid type determines the molecular structure of head and tail groups, which can affect membrane mechanics at nanoscale and subsequently cell viability under mechanical loading. Hence, using molecular dynamics simulations, the current study investigated seven membrane phospholipids and the effect of their structural differences on physical deformation, mechanoporation damage, and mechanical failure of the membranes under tension. The inspected phospholipids showed similar yield stresses and strains, as well as pore evolution and damage, but significantly different failure strains. In general, failure occurred at a lower strain for lipids with a larger equilibrium area per lipid. The obtained results suggest that larger headgroup structure, **greater degree of unsaturation**, and tail-length asymmetry influenced the phospholipids' ability to pack against each other, increased the fluidity and equilibrium area per lipid of the membrane, and **resulted in lower failure strain**."

Wu, et al. (2017): On 20th March 2017 the journal *Scientific Reports* published a paper by [**Chia-Lung**] **Wu** [[University of Rochester biography](#)], *et al.* titled "**Serum and synovial fluid lipidomic profiles predict obesity-associated osteoarthritis, synovitis, and wound repair**" [[full text online](#)], in which the authors present data consistent with the **C15 hypothesis** [see own entry **IMPORTANT**] concerning the dangers of cell membrane "fragility" [they do not yet use that precise word however - Ed.]. Here is the formal *PubMed* Abstract in full (**palmitoleic acid** [see own entry] is a C16:1, omega-7 monounsaturated fatty acid) ...

"High-fat diet-induced obesity is a major risk factor for osteoarthritis (OA) and diminished wound healing. The objective of this study was to determine the associations among serum and synovial fluid lipid levels with OA, synovitis, adipokine levels, and wound healing in a pre-clinical obese mouse model of OA. Male C57BL/6J mice were fed either a low-fat (10% kcal) or one of three high-fat (HF, 60% kcal) diets rich in **saturated fatty acids (SFAs)**, ω -6 or ω -3 **polyunsaturated FAs (PUFAs)**. OA was induced by destabilization of the medial meniscus. Mice also received an ear punch for evaluating wound healing. Serum and synovial fluid were collected for lipidomic and adipokine analyses. We demonstrated that the serum levels of ω -3 PUFAs were negatively correlated with OA and wound size, but positively correlated with adiponectin levels. **In contrast, most ω -6 PUFAs exhibited positive correlations with OA, impaired healing, and inflammatory adipokines. Interestingly, levels of pentadecylic acid (C15:0, an odd-chain SFA) and palmitoleic acid were inversely correlated with joint degradation.** This study extends our understanding of the links of FAs with OA, synovitis and wound healing, and reports newly identified serum and synovial fluid FAs as predictive biomarkers of OA in obesity."

That's All, Folks 🎵🎵

[\[Home\]](#)