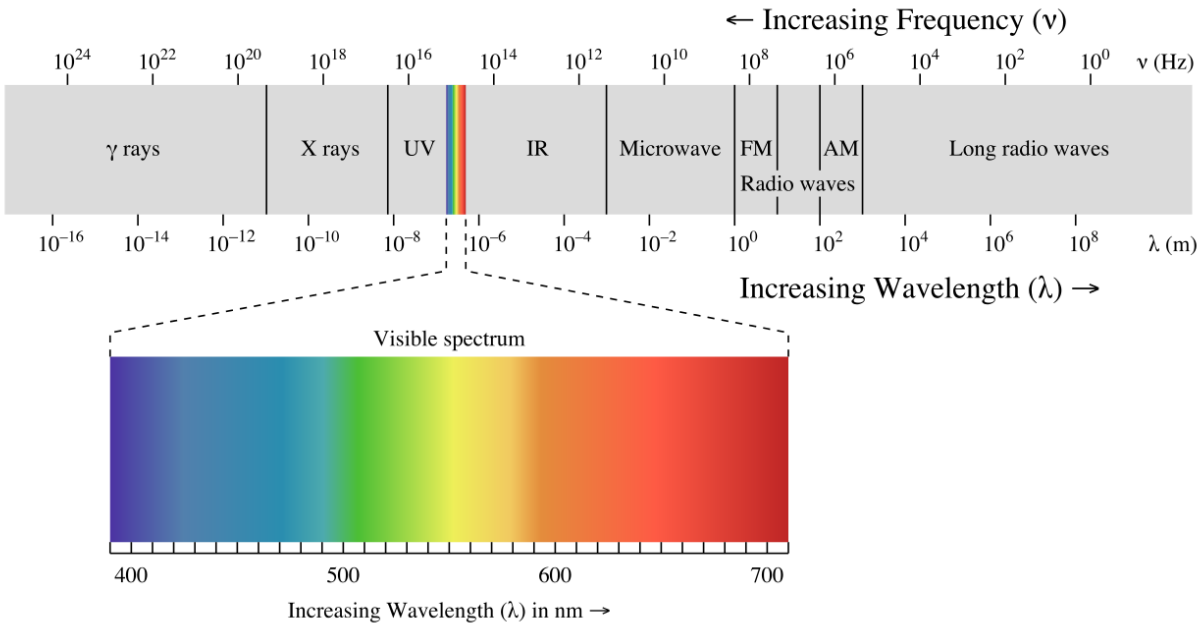
What Exactly is Blue Light?

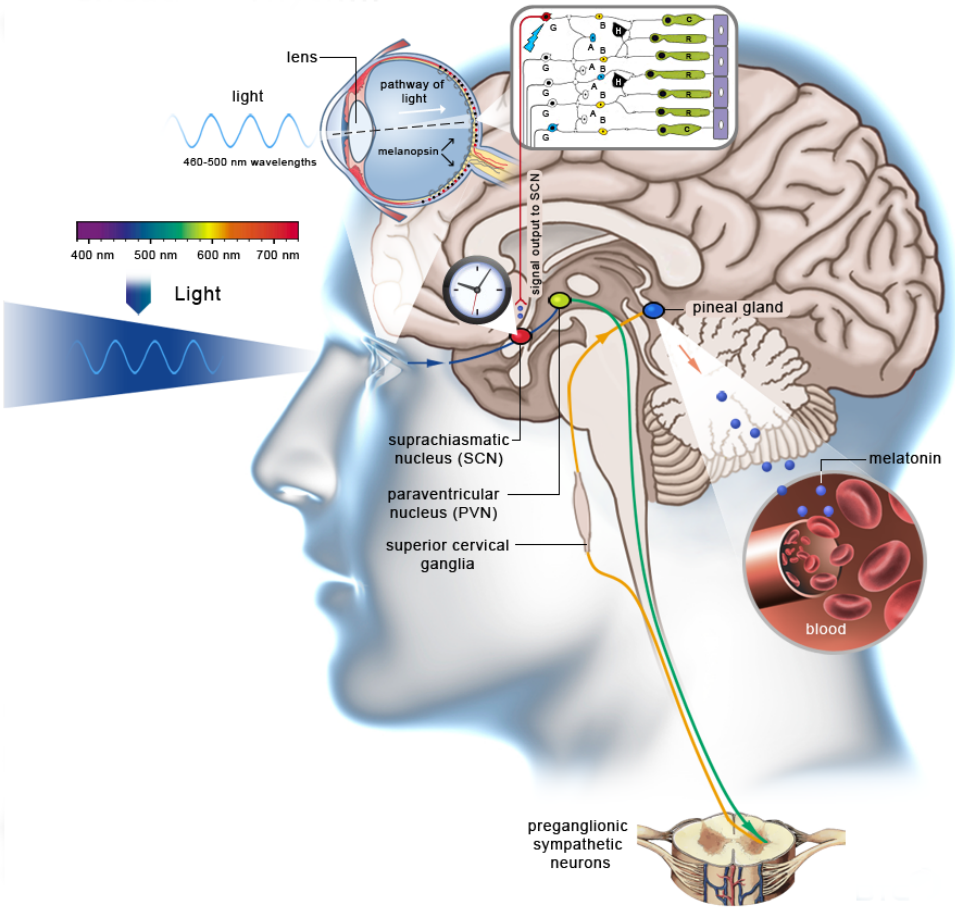
All light is simply a form of energy, and contains both an electric field and a magnetic field. Thus, all light is what is known as electromagnetic radiation or electromagnetic fields (EMF). **Electromagnetism** is one of the fundamental forces of nature, and the electromagnetic force is carried by one of the bosons, namely the photon.

Photons, which come from the sun, carry electromagnetic energy to earth in the form of light, where living organisms make use of it in specific ways unique to their biology. Plants, for instance, use sunlight to make sugar and oxygen during photosynthesis. Humans also make use of the sun's electromagnetic radiation for our own biological processes. Indeed, all living creatures require this form of energy in order to maintain health and survive. It is thus critical that we understand our body's unique light requirements if we are to maintain optimal health.

The electromagnetic spectrum encompasses a broad range of frequencies, all of which are carried from the sun (and other sources in the universe) to the earth by photons. The EM spectrum consists of energy in the form of to x-rays, visible light, radio waves and microwaves, to name a few. The energy signal of the station that your radio tunes into when it plays music (e.g., Mix 94.5 means 94.5 MHz) is actually a *light signal*, we just can't see this form of energy because our eyes don't have photoreceptors for that part of the spectrum. The only part of the spectrum humans can see is called the visible spectrum. This is what we normally think of as light. It contains all the colours of the rainbow. Some animals have photoreceptors for other parts of the EM spectrum. For instance, birds can see colours in the ultraviolet range - their plumage is much more colourful and vivid than we humans can perceive!



The **Visible Spectrum** is made up of different ‘colours’ of light. Each colour is simply a different wavelength of the electromagnetic (or ‘energy’ wave). For instance, red light is around 700nm, while blue light is around 450nm. Thus the colour of light we see is determined by the wavelength of that light. The different wavelengths of light are detected by photoreceptors in the body, and based upon the specific wavelength of the light signal these receptors detect, they will then relay specific signals to other parts of the body to undergo specific processes such as gene expression.



The Suprachiasmatic Nucleus (SCN) is your body’s master clock. It is a small region of the brain situated in the hypothalamus, just above the optic chiasm, where the optic nerves from each eye intersect. Different frequencies of light (natural ones from the sun and artificial ones from various light sources) are photonic signals. When these light signals hit the retina of your eyes they get turned into electrical signals, which are then relayed to the SCN via the retinal-hypothalamic tract. The SCN, your brain clock, interprets the light signal according to its frequency and wavelength to determine what time of the day or night it is. Your body has different biological processes which need to be maintained in accordance with the circadian rhythms of the earth. For instance, we are diurnal so sleep when it is dark and are awake during the day. Once the SCN has interpreted the light signal it then relays this information forward to hormone producing glands in the brain such as the pituitary gland and the pineal gland.

In order for your body to functional optimally you need to maintain proper light and dark exposure, in line with the earth's circadian rhythms.

Melatonin, the hormone of sleep, is produced in the pineal gland in the *morning*. When your eyes are exposed to AM sunlight containing the correct photon signal (a combination of UVA (ultraviolet-A: 315-400nm) and IR (Infrared: 700-1000nm) light), this information is transmitted along the retainal-hypothalamic tract to the SCN. This part of the hypothalamus then sends its own instructions to the pineal gland to upregulate the production of melatonin.

Melatonin is *produced* in the morning but is only *activated* at night when it is dark. Following approximately 4 hours of darkness the brain receives the signal to activate melatonin, which then facilitates sleep. In terms of light frequencies, darkness means the absence of blue and green light (400-550nm). When your environment contains these light frequencies the activation of melatonin will be inhibited and you will experience delayed sleep onset. Television screes, laptops, phones, ipads, and LED lights all emit strong blue-light signals and are thus significant circadian disruptors.

If you experience difficulty with sleep onset or sleep maintenance, this is a sign that your circadian rhythms are disrupted. If you are not getting your eyes exposed to morning sunlight (for instance because you are spending too much time inside or you are wearing sunglasses when you are outside) then your body will not be able to produce melatonin. Alternatively, if you are using artificial lights at night and are utilising blue-lit technology, you will not be able to activate melatonin adequately. Thankfully, there are ways to filter the disruptive blue/green signals from your devices so that you can still enjoy technology of an evening. It is essential to install blue-blocking filters on all such devices if you are to maintain proper health. Light is in fact one of the most important aspect of your body's nutritional requirements!

Blue Blockers
Fashion Statement or Safety Gear?



Blue blocking glasses are becoming more and more popular - Bono is a well-known advocate. But blue blockers are more than just a fashion trend. With the increased prevalence of digital screens and LEDs in our lives, it is essential that we take precautions when using this technology, in order to protect our eyes and brains from the damaging frequencies. This is especially important for children, who often spend many hours online or gaming. Without a filter, staring at your computer screen is the equivalent of staring at the midday sun! If you don't like wearing glasses you can also use a filter on your device. There is free and paid for software available online to download. We like IRIS.

You can purchase day-time glasses and night-time glasses to protect your eyes from digital screens and artificial lights. The Brain Training Centre is an affiliate of the Australian company BluBlox. We recommend their products as they are the only glasses on the market which block 100% of light in the 400nm-500nm range.

Day time glasses are not intended to block the entire blue spectrum, only those parts of the spectrum that computer screens, LED and fluorescent lighting are rich in. This protects your eyes when indoors and thus prevents downstream hormonal disruption. Daytime blue blockers are not as orange, they're slightly yellow or clear. If you work with a lot of computers and TV screens, and need to wear spectacles, you can get prescription lenses with built in blue filters. For late-afternoons and early evenings, go with standard blue-blockers, with an orange tint.



Night-time blue blockers are intended to cut out entire blue and green portion of the visible spectrum. These glasses should be dark orange, but even better if red. Blue-green light needs to be blocked at night in order to maintain healthy circadian rhythms, so you want your glasses to block 400-550nm wavelengths. Not all blue-blockers block this entire range. The darker red the glasses, the better they are at blocking these wavelengths.

You can also adjust your phone settings to filter out the blue light. This is not the Night Mode option but the Colour Filter option. On the iPhone, this can be found under Settings > General > Accessibility > Display Accommodations > Colour Filters. Turn on Colour Tint, and slide the intensity and hue to the highest option you can tolerate. You can also add a shortcut to quickly turn this filter on and off if need be (such as when outside under intense sunlight). To Add a shortcut, scroll to the bottom of the Accessibility page and tap Accessibility Shortcut. Select Colour Filter. We also recommend using the Reduce White Point option at night too. You will see this under the Colour Filter option in shortcuts.

BLUE LIGHT TOXICITY



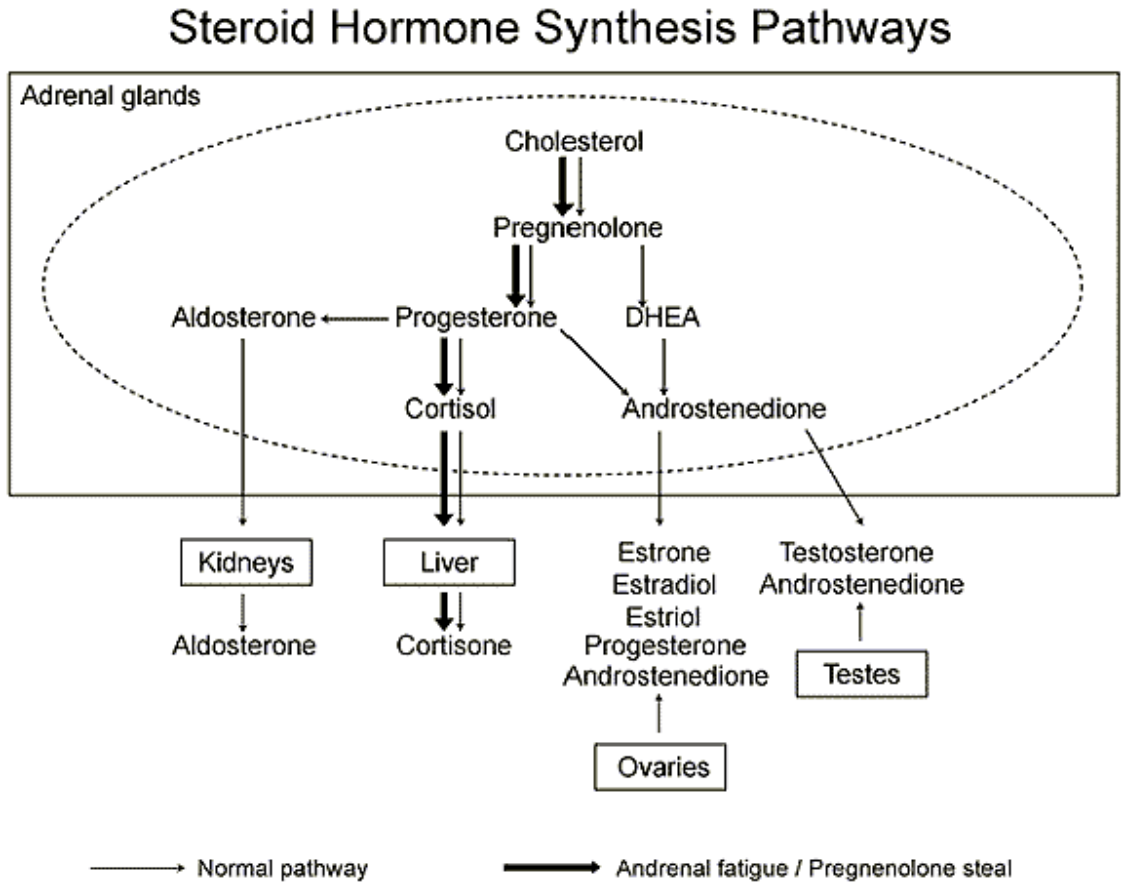
We do actually need blue light in our environment, but the timing of our exposure to it is critical. Blue light from the morning sun stimulates the release of cortisol, and this is what naturally wakes you up. Your cortisol should normally be highest in the AM. Blue light from the rising sun hits the retina which relays a unique electrical the signal to the SCN in the brain. The SCN then signals the anterior pituitary to release Adrenocorticotropin Hormone (ACTH), which in turn signals the adrenals to release cortisol. This is how light influences your health, including your. Cortisol is a stress hormone, it raises your blood sugar and keeps your body in a state of sympathetic nervous arousal. This is why excessive use of computers and the like can make you feel irritable and jittery, and then eventually drained and fatigued.

The natural production of cortisol only ceases when UVA light (which shows up shortly after sunrise) hits the retina and the message to stop cortisol production is received by the brain. Your body will continue to produce cortisol if you have little-no UVA exposure because you're inside all day under artificial lights which contain no UV, and the windows in your home/offices/car all filter UV, as do your spectacles and sunglasses, clothes and sunscreen. This means cortisol is being produced in excess.

Low Sex Drive? Light and Hormone Production

The structural backbone of many hormones is a molecule called pregnenolone, which comes from cholesterol. Pregnenolone makes cortisol as well as DHEA (dehydroepiandosterone). DHEA produces sex hormones like oestrogen and testosterone. When cortisol is produced in excess, as it is when you have is chronic blue light exposure, pregnenolone is used to prferentially produce cortisol at the expense of DHEA. Cortisol is a driver of the sympathetic response necessary for fight/flight. One function of cortisol is to increase blood glucose (sugar) levels to give a massive boost of energy during an emergency (fight/flight).

Thus, when signalled, the production of cortisol always takes precedence over the production of sex hormones, since the body favours short-term survival over long-term reproduction. This means excessive blue light can actually raise your blood sugar levels to pre- and even diabetic levels, despite consuming little or no sugar in your diet! This excess cortisol results in chronically elevated blood glucose, which in turn leads to insulin-resistance, which then causes inflammation and diseases like arthritis and diabetes! Excess cortisol will also result in lowering your testosterone, due to pregnenolone steal.



Cortisol and melatonin work in opposition. Simplistically, one wakes you up, the other puts you to sleep (though there are many other more nuanced functions too).

When your eyes and skin are exposed to blue light at night, this exposure prevents the activation of melatonin. Melatonin requires 4 hours of constant dark in order to be stimulated (it doesn't have to be pitch black, simply lacking the blue and green portions of the spectrum. Red and orange won't interfere with melatonin so candle light or red lights at night are good). If melatonin isn't being released at night, your circadian rhythms will be misaligned and your sleep quality and quantity will suffer as a result. Essential repair process occur during sleep. One key process is AUTOPHAGY (from the Greek 'self' 'eating') which is the body's way of recycling damaged cells. Another other key process is APOPTOSIS (the second p is silent) - this is commonly called 'cell suicide', or 'programmed cell death'. Apoptosis is essential for the body to get rid of cells that are damaged beyond repair. When cells continue to proliferate when they shouldn't this leads to diseases like cancer. Your mitochondria mediate the balance between autophagy and apoptosis, based on the light signals it gets through your eyes and skin.

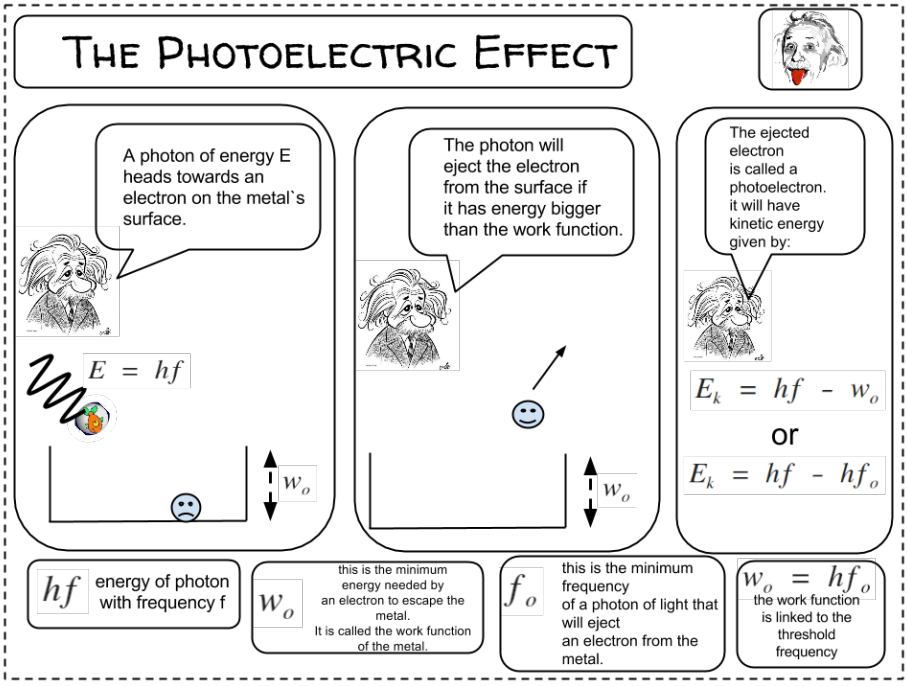
Why skin?

Your eyes detect different light frequencies/wavelengths via photoreceptors. But your skin also contains photoreceptors. This is why it's not only imperative to protect your eyes from blue light at night by wearing blue blockers, but it's also essential that you cover your skin to prevent the photoreceptors in your skin from likewise receiving disruptive signals. There are also photoreceptors INSIDE YOUR BODY, in the gut and subcutaneous fat. This means that eating after sunset will also disrupt your circadian rhythms in a similar way that looking at a computer screen will.

How? Plant sugars and starches and produced via photosynthesis - the light frequencies the plant was grown under is information that becomes embedded in its chemical/ physical makeup. Any animal that eats a plant is consuming this 'light barcode' (information about where and when on the planet the plant was grown). Animals eat these plants, and then we eat these animals. When humans eat food (plants or animals) we are essentially eating sunlight, since ALL FOOD BREAKS DOWN TO PROTONS AND ELECTRONS. These protons and electrons from our food contain the information that originally came from the photons (sunlight) which grew the plant in the first place (photosynthesis = synthesis from photons!). The information is carried in the spin of these electrons, and the spin is determined by the photon.

Eating at night is fundamentally the same as exposing yourself to light when you should be in the dark. Eating at night will disrupt your sleep cycle and mess up your autophagy/ apoptosis balance and eventuate in a disease state - this ranges from low mood and irritability, tiredness, to full blown Parkinson's and cancer. Yes.

The **photoelectric effect** is how sunlight ('photo') becomes the DC current ('electric') in your body. But rather than the current coming from a metal, it comes from DHA. (This requires DHA fish oil to be in your cell membranes. The DHA is basically the pool of electrons which can be programmed by the sun). So as your body produces its DC current, how that current is used in the body (i.e., where electrons will go - which means which hormones, neurotransmitters will be produced etc) is governed by the photons that originally generated it. Health is all about LIGHT!



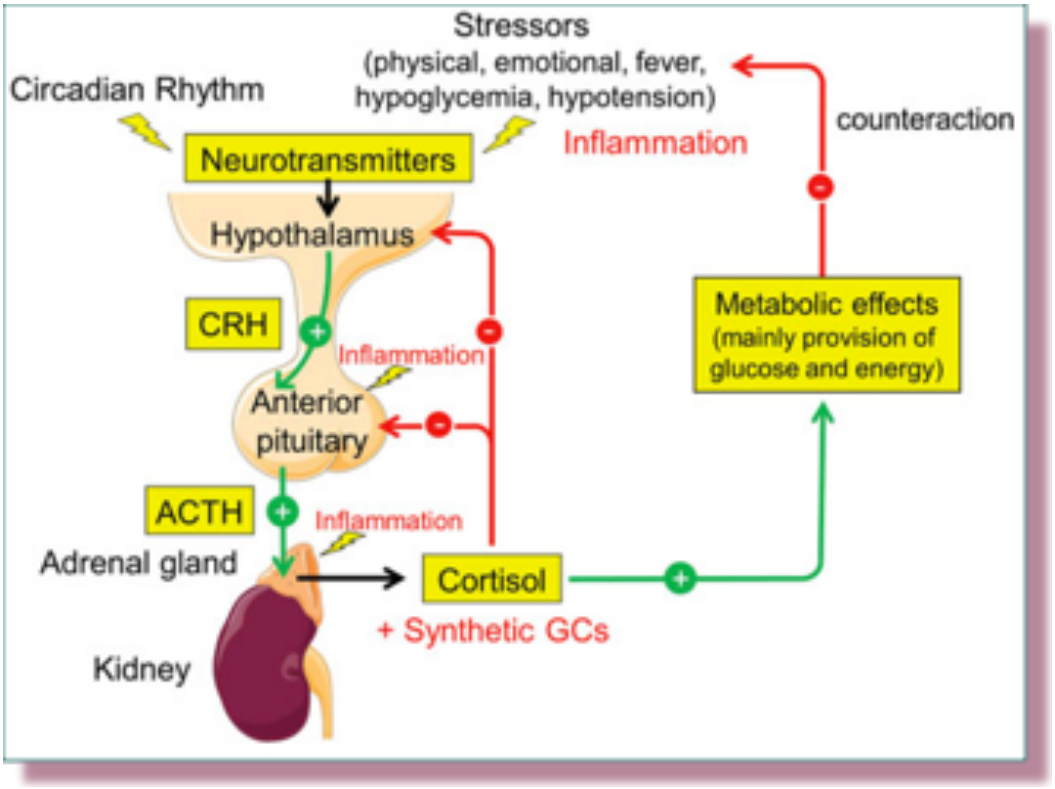
HOW CAN ARTIFICIAL BLUE LIGHT INDUCE DIABETES?

Type II Diabetes is a state of advanced insulin resistance. The same process is involved in Alzheimer's disease. In fact, AD is now being referred to as Type III Diabetes.

Insulin is a hormone, produced in the pancreas, which is responsible for taking sugar out of the blood. More than 5g of sugar in the bloodstream is a toxic level. When blood sugars are constantly in excess, the pancreas works overtime producing insulin in order to keep blood sugars at a safe level. Eventually the pancreas gets worn out, and the insulin receptors become insensitive to insulin as well. Basically the whole system gets worn out, and you become INSULIN RESISTANT. Your body is no longer able to produce enough insulin to keep blood sugars down, and the little insulin that it does produce is no longer effective because your cells are no longer sensitive to their signal. The result is type II diabetes.

CORTISOL is also a hormone. It has the opposite effect of insulin, in that it *increases* your blood sugars. Cortisol is known as the STRESS HORMONE. When you're in a stressful situation your body floods its circulation with glucose (sugar), which acts as rocket fuel to give you the energy you need to survive. Sugar is rocket fuel for the body. But again, too much of this sugar fuel for too long will wear out the insulin-sensitivity of cells, as well as the insulin producing cells of the pancreas. Anything that raises your cortisol will also raise your blood sugars and perpetuate the diabetic state, including emotional stress, mechanical stress like exercise, other physical stress like toxic chemicals, and nnEMF stress.

Some level of stress is essential for growth - this is called eustress. But any of these sources of stress in excess will elevate cortisol to the level where is starts to negatively impact upon the health of the body, resulting in inflammation and disease.



CUT OUT ALL SOURCES OF SUGAR, STRESS AND EXCESS CORTISOL

- Sugar, pasteurised milk, soda and fruit juice
- Wheat, grains, cereals
- Alcohol
- Processed foods
- Vegetable oil, canola oil
- Artificial lighting at night
- Blue light devices (unless using protection like blue-blockers)
- Emotional Stress, worrying, etc
- Toxic Relationships
- Overworking
- Poor Sleep
- Exhaustive physical stress
- Excessive exercise

INCREASE ANYTHING THAT WILL HELP YOU RELAX AND DECREASE CORTISOL:

- Loving relationships
- Meaningful work
- Natural sunlight
- Healthy, non-fluoridated water (structured, energised, low deuterium is ideal)
- Block artificial light with IRIS software and BLUE BLOCKERS
- Time in Nature
- Healthy food, especially seafood.
- High quality minerals (e.g., Quinton, Celtic Sea Salt)
- Good quality sleep in total darkness
- Social connections - time spent with family and friends
- Meditation, mindfulness, yoga, tai chi, etc
- Unstructured play
- Hobbies and creative endeavours
- Quality entertainment