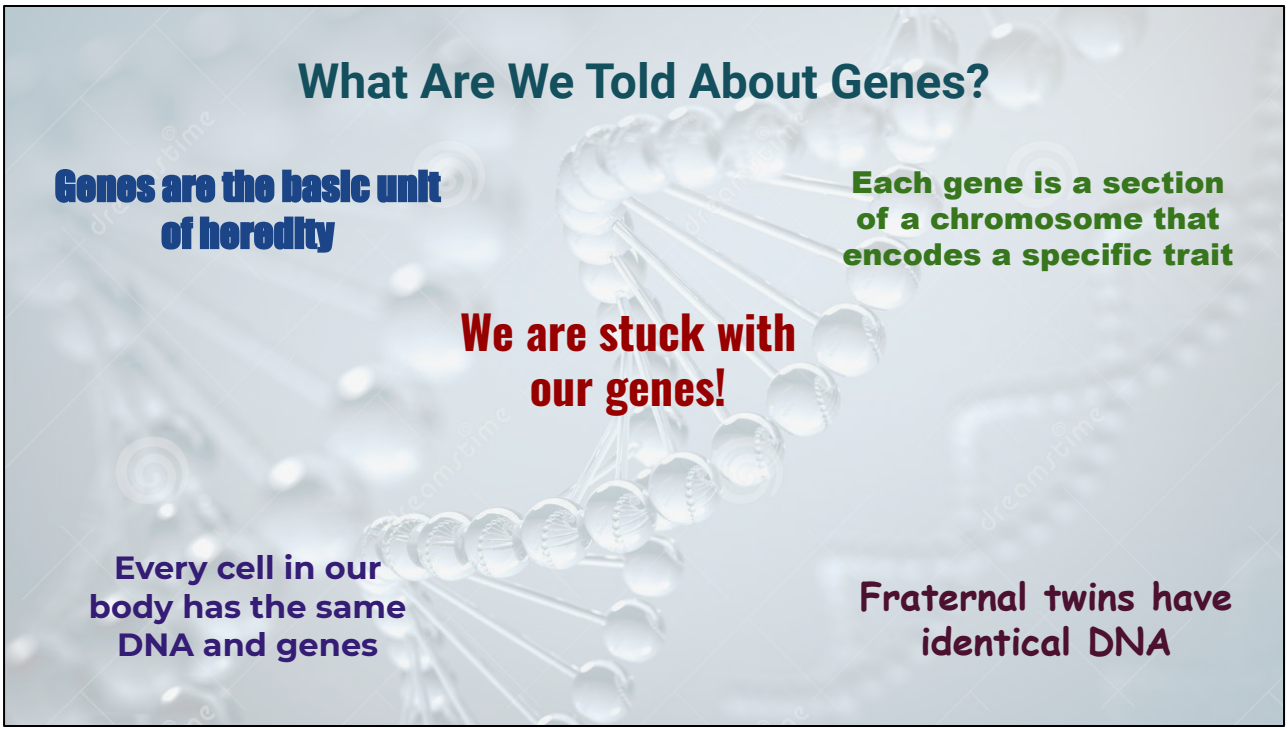
Thank you Larry for the very kind introduction. I was so honored to be asked to be a speaker at this event. It feels a little strange to me, because I am not a practicing spiritual teacher. Most of the topics that I am adept at talking about are pretty nerdy. But I think that I have found a topic for today that “reaches across the aisle”. It is a topic that I am fascinated by and pretty passionate about. I think that that by the end you will understand its connection to the theme of this Gathering, “The Harmonics of Healing”.

Disclaimer:

- I am not currently a geneticist and the last time I did genetics research was nearly 40 years ago. But I have spent hundreds of hours over the last 10 years trying to keep up with what is going on in the fascinating world of genetics.
- I feel compelled to mention the research area that I am going to talk about is changing on a daily basis. A few slides in this talk will likely be out of date tomorrow.
- In addition, some of things that I will be talking about today are controversial. Not all scientists agree with them; however, I did my best to make sure that research that I talk about here is well done and repeated or substantiated by others.



- We are taught from our basic biology that genes are the basic unit of what we inherit from our parents. That still appears to be the case.
- That genes are a section of a chromosome that represents/encodes a specific trait. Still true.
- Since all our cells come from the same original cell, they all can the same DNA and genes. There is no reason to doubt that.
- Fraternal or identical twins have the identical DNA. Still yes.
- And last but not least, we are stuck with our genes! We don't have a choice and we will have to deal with what the universe has given us.

But what about …?

If all our cells have the same genetic material, why aren't all cells identical?

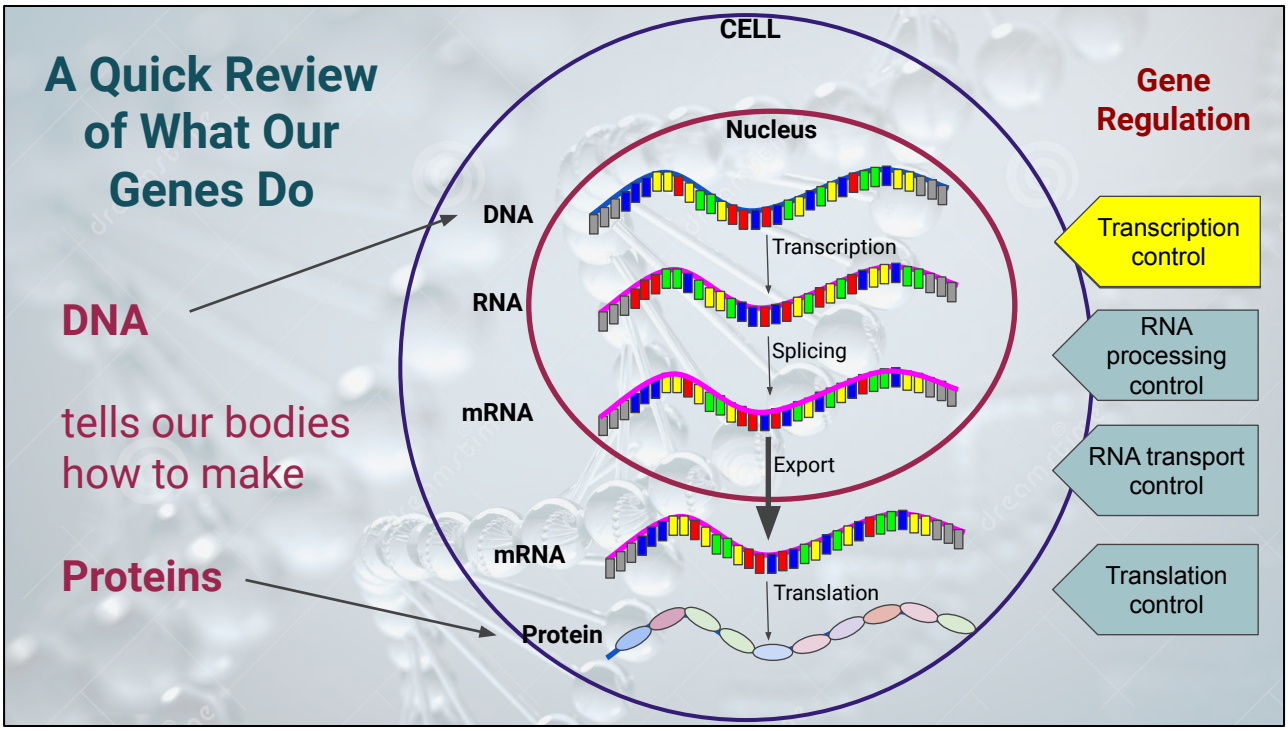
And how do we change so much from infancy to adulthood to advanced age?

If humans share 98.8% of their DNA with chimpanzees, 90% with cats, and 82% with dogs, how come we are so different?

Since the early 1970s, a group of scientists have been trying to answer certain questions that they find baffling. They include:

- How can my skin cells, my liver cells, my lung cells, and the cells in my eye have the same genes. They look different and they have totally different functions. There are about 200 different kinds of cells in the human body that perform very different functions, and yet they have identical DNA. How does that work?
- Think about how much we change from infancy through puberty to adulthood and then on to advanced age. Our genes don't change, so how do all these physical changes occur.
- We chimpanzees, cats and dogs share huge amounts of DNA. This seems to make no sense. We share huge amounts of DNA, but we look, work, and act very differently.
- It is questions like these that started the study of Epigenetics.

- Epigenetics is the study of how the functioning of our genes can change without changing the DNA.
- That is, the modification of how the genes are expressed rather than the modification of the genes.
- The statement on the slide introduces the term “gene expression”, which means when/how your genes are used.



The important points:

- DNA Tells our bodies how to make protein and actually that is mostly enzymes.
- Making protein from DNA is a 4 step process.
- Each step of the process can be regulated — that is turned on or off, or sped up or slowed down.
- The most commonly regulated step (and now the most highly studied) is the first one, transcription control.
- Translation control is a step that has recently come under more scrutiny.
- The proteins that the body makes is more than just the proteins that make up our muscles, skin, and cell walls. The most common “proteins” in our body are enzymes. Those compounds that run all the chemical reactions in our bodies. And it is important to understand that our bodies are one large chemistry set.

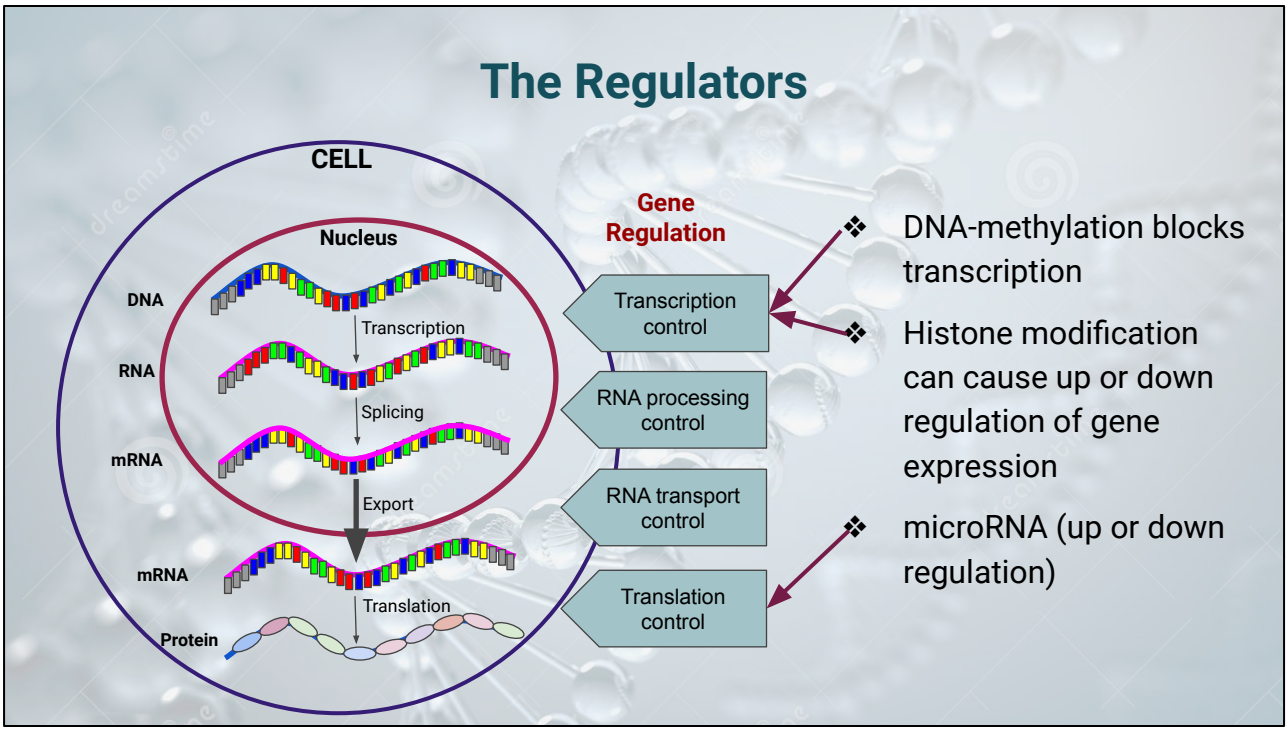
About 5% of our genes are not regulated. How many genes is that? Well, Scientists estimate that we use somewhere between 20K and 25K human genes — so let's say we have 20K human genes. That means there are only about 1000 genes that **aren't regulated**— they always get expressed. They are essential genes and are often termed "housekeeping genes" because the are required to keep all cells running.

The other 95% — can be regulated. There are two other category of genes that I would like to mention at this time:

1. About 5% (~1000) of our genes are **tissue-specific genes**; these genes are only expressed in specific tissues; it is these genes that differentiate between cells; these are the genes that set the function of the cell; skin versus liver versus heart versus muscle.

2. There is also about 5% of our genome that are **age-specific genes** — they are expressed at specific times of our development. Some are only express when we are in the womb or when we are young children. Some get turned on as we get older.

Even with the 15% of genes that we have mentioned here, there is still another 85% of our genes that can be regulated for other reasons. That is about 17,000 genes.



- The most common type of epigenetic modification mechanism is called **DNA methylation**. DNA methylation involves the attachment of small chemical groups called methyl groups (each consisting of one carbon atom and three hydrogen atoms) to DNA building blocks. When methyl groups are present on a gene, that gene is turned off or silenced, and no protein is produced from that gene.(Note: they attach to the Cytosine-phosphate-Guanine (CpG) dinucleotide sequence of DNA; the so-called CpG island.)

- Another common epigenetic change is **histone modification**. Histones are structural proteins in the cell nucleus that package and order DNA into units. DNA wraps around histones, giving chromosomes their shape. Histones can be modified by the addition or removal of chemical groups, such as methyl groups or acetyl groups (each consisting of two carbon, three hydrogen, and one oxygen atoms). The chemical groups influence how tightly the DNA is wrapped around histones, which affects whether a gene can be transcribed or not.

- **miRNAs** (microRNAs) are short non-coding RNAs that regulate gene expression post-transcriptionally. They generally bind to the 3'-UTR (untranslated region) of their target messenger RNA (mRNA) and **repress protein production** by destabilizing the messenger RNA. (Nerd Note: MicroRNAs repress the expression of a large number of messenger RNAs (mRNAs) by direct binding to specific sequences localised in the 3′ untranslated regions of these target mRNAs [18].) They affect about 30% of the human genes. We currently have identified about 3,000 of them, but we know that there are a lot more.

Sometimes we want to have our genes regulated or turned off, and sometimes we want them on. Why? There are a couple of reasons:

- The proteins that are created/specified by our genes often have more than one function. They actually might be involved in many chemical reactions in the body. Or even more likely, The chemical reactions that they are involved in have many different effects within the body. An example is MTRR. This enzyme performs the very important function of changing Cyano-cobalamin into methyl cobalamin. It changes an inactive form of B12 into an active form of B12. Methyl-cobalamin (the active form) is necessary for the formation of healthy hemoglobin and healthy nerve cells, among other things. A lact of methylcobalamiin in the body is associated with multiple sclerosis, fibromialgia, Crohn's disease, and a sensitivity to high altitude.So our genes often serve multiple purposes. What is interesting is that some of those effects we would consider “good” and others of those effects we might consider “bad”
- We also have genes that have complementary functions. For example, we have genes that create proteins that promote cancer and we have genes that create proteins that suppress cancer. We have genes that promote inflammation, and we have genes that help lower inflammation.
- The point here is that we don’t want all our genes to be on or off, our preference based upon our idea or ultimate health could be either on or off.

What Causes “Bad” Epigenetic Changes?

- Contagious Diseases (viruses and bacteria)
- Toxins (negative environmental exposure)
- Lifestyle choices
  - Recreational drugs
  - Smoking
  - Alcohol consumption
  - Highly-processed foods
  - Eating too much food
  - Stress, especially extreme stress
  - Lack of sleep

- Viruses in particular have been shown to modify our epigenome. DNA tumor viruses including members of the **polyomavirus, adenovirus, papillomavirus, and herpes** virus families are presently the subject of intense interest with respect to the role that epigenetics plays in transforming a normal cell to a cancer cell.
- Not only due toxins have a short-term effect on our body chemistry, but with long-term exposure they change our epigenome. (Nerd note: Epigenetic toxicity is a phenomenon in which a chemical substance affects epigenomes and exerts undesirable effects on living organisms, which may explain the long-term effects of chemical substances and the predisposition to diseases due to environmental factors including chemicals.)
- And then we have lifestyle choices. **We are not talking about occasional use, but chronic poor choices.** And they include a long list of things that we have already been taught to avoid, but now we are beginning to understand that chronic exposure to this things causes changes to our epigenome.
- Let’s looks at some of the evidence.

Nicotine

Nicotine, no matter which way you ingest in has shown to have significant effects on the epigenome. There are two particular studies that I think you might find interesting.

- The epigenetics of cigarette addiction was studied in about **16,000 humans**, **including never smokers, current smokers, and those who had quit smoking for up to 30 years**.[12] In blood cells, more than 18,000 CpG sites (of the roughly 450,000 analyzed CpG sites in the genome) had frequently altered methylation among current smokers. These CpG sites occurred in over 7,000 genes, or roughly a third of known human genes.

  The majority of the differentially methylated CpG sites returned to the level of never-smokers within five years of smoking cessation. However, 2,568 CpGs among 942 genes remained differentially methylated in former versus never smokers. **Such remaining epigenetic changes can be viewed as "molecular scars**". (Reference Robison AJ, Nestler EJ (October 2011). "Transcriptional and epigenetic mechanisms of addiction". *Nature Reviews. Neuroscience*. **12** (11): 623–37. doi:10.1038/nrn3111. PMC 3272277. PMID 21989194.

  Answer to question: This study is with cigarettes, so the individuals are exposed ot more than just nicotine. The tars and other chemicals in the cigarette smoke could be making some of these changes.

- Chronic nicotine intake in mice alters brain cell epigenetic control of the brain gene, FosB, which is associated with addiction. This same gene is implicated with cocaine.
- Let's talk about human versus animal research in this area. OK. I don't like research on animals, so I am in somewhat alignment with the PETA followers out there. But let me talk about what this animal research brings to the party.
    - We can put 100 mice in a highly controlled environment. Give them the same food, the same water, the same exposure to chemicals, the same exercise, and so on. They we can take blood tests, then expose them to whatever we want for what ever duration, then take our second blood test to see what happens to this group of mice. Scientist can get really good results this way and can control outside influences so that the results can be substantiated.
    - You can control humans in this way, so the results are less reliable, and it is difficult to eliminate all potential factors.

Cocaine Abuse

- Cocaine promotes (and in some cases turns on) several genes associated with hyperactivity and reward responses to addictive substances (cFos, BDNF, and Cdk5).
- It modifies the epigenome of genes that better enable us to deal with stress and depression — the result is a general vulnerability to stress and depression.
- Increased expression of the CREB gene which is associated with learning and memory issues (brain fog) as well as depression

Alcohol

- **Accelerates epigenetic aging —** scientist have devised a method for estimating a person's age more accurately than their chronological age (called an epigenetic clock that measures the age of tissues). It involves
  - Changes in patterns of DNA methylation
  - The state of the Telomeres at the ends of the chromosomes
- **Creates a dysfunctional blood-brain-barrier** — allowing chemicals to enter the brain that should not pass through. The results was significant cognitive impairment.
- **Decrease in SAM** levels which results in hypomethylation and negatively impact proper epigenetic regulatory mechanisms.

"It was a huge surprise to us that metabolized alcohol is directly used by the body to add chemicals called acetyl groups to the proteins that package DNA, called histones," said the study's senior author Shelley Berger, PhD, the Daniel S. Och University Professor in the departments Cell and Developmental Biology and Biology, and director of the Penn Epigenetics Institute. "To our knowledge, this data provides the first empirical evidence indicating that a portion of acetate derived from alcohol metabolism directly influences epigenetic regulation in the brain."

Eating Too Much

- Mice that are chronically overfed have memory impairment and decrease hippocampal activity. The belief right now is that this is likely caused by the down-regulation of memory genes (including Sirt1) via DNA methylation.
- Whal et al. (2017) performed an epigenome-wide association study to show that body mass index is associated with widespread changes in DNA methylation.
- (Nerd note: A 2016 study by Heyward et al. found that mice that were chronically overfed had memory impairments and decreased hippocampal Sirt1.3 Decreased expression of several learning and memory genes, including Sirt1, was associated with an increase in DNA methylation.)

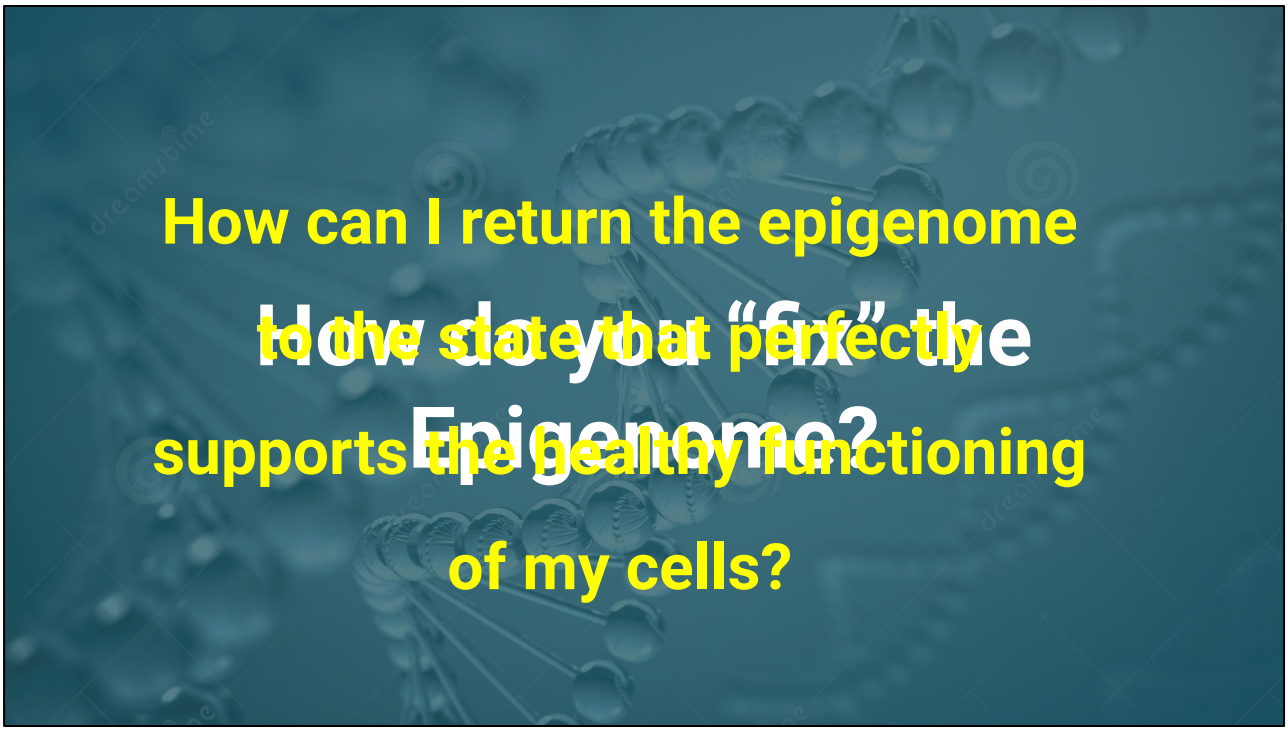
Sugar & a High-glycemic Diet

Hyperglycemia is highly implicated in the promotion of cancer

- Turns off the tumor suppressor TET2, and are now implicated in promoting some kinds of cancers.
- Through a rather complicated process, hyperglycemia is strongly implicated in increasing inflammation. It turns on genes associated with increasing inflammation and turns off genes that suppress inflammation.
- Unclear whether sugar changes expression of obesity genes!

We now understand that both chronic, low-grade stress and severe trauma affect the epigenome.

- For many years, the mechanism by which a traumatic memory is engraved in the brain leading to post-traumatic stress disorder (PTSD), has been a mystery. Epigenetics is unlocking this mystery. In people who have experienced trauma in childhood, demethylation of the DNA methyl group in the glucocorticoid responsive sequence of FKBP5 was observed (Klengel et al., 2013, Szyf, 2013). As a result, the **expression of the FKBP5 gene tends to be enhanced**, the function of the glucocorticoid receptor is suppressed, the sensitivity to stress increases, and the risk of developing PTSD increases. Whereas trauma experienced after someone becomes an adult does not lead to DNA demethylation, trauma experienced in early childhood is essential for DNA demethylation to occur.



I titled this slide this way, because that is the way we humans think about it. “How can I fix the situation.?”

But I really should have worded the slide “How can I return the epigenome of my cells back to the state that perfectly supports their functions in the body and doesn’t promote aging or diseases.” Fixing really isn’t the right perspective.

Things to Avoid

- Toxic chemicals
- Recreational drugs
- Nicotine
- Alcohol
- Over-eating
- Lots of processed food
- A high-glycemic diet
- Stress

We can focus on what to get rid of, but I am happy to report that there are all sorts of things that we can add to our lives that help our body/ support our body in putting the epigenome back to its most “healthy” state:

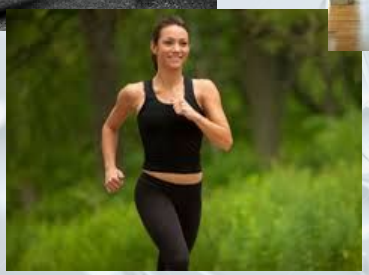
- Lots of fresh fruit and vegetables
- Exercise
- Sleep
- Meditation

Fresh Fruit and Vegetables

- **“Put simply, what you eat won’t change the sequence of your DNA, but your diet has a profound effect on how you “express” the possibilities encoded in your DNA. The foods you consume can turn on or off certain genetic markers which play a major – and even life or death – role in your health outcomes.”**
- Fruits provide a wealth of phytochemicals and bioflavanoids and many fruits are being studied right now for their epigenetic benefits. In particular, Apigenin has been linked to preventing prostate and breast cancer and slowing tumor growth
- While we’re far from being able to assert that without caveats, researchers have indeed discovered that **eating cruciferous veggies** can protect against a range of cancers, and remarkably, can actually slow the growth of cancer cells in pre-existing tumors by altering some of the epigenetic markers involved in cancer. It appears that sulforaphane in these vegetables target epigenetic alterations in specific cancers. In one study, it was found that subjects who consumed at least one portion of cruciferous vegetables per week as compared with those with no or occasional consumption were associated with a significantly reduced risk of oral cavity and pharynx, esophageal, colorectal, breast, and kidney cancer.
- The union/garlic family also has a sulfur-based compound that appears to slow cancer growth also.

Exercise





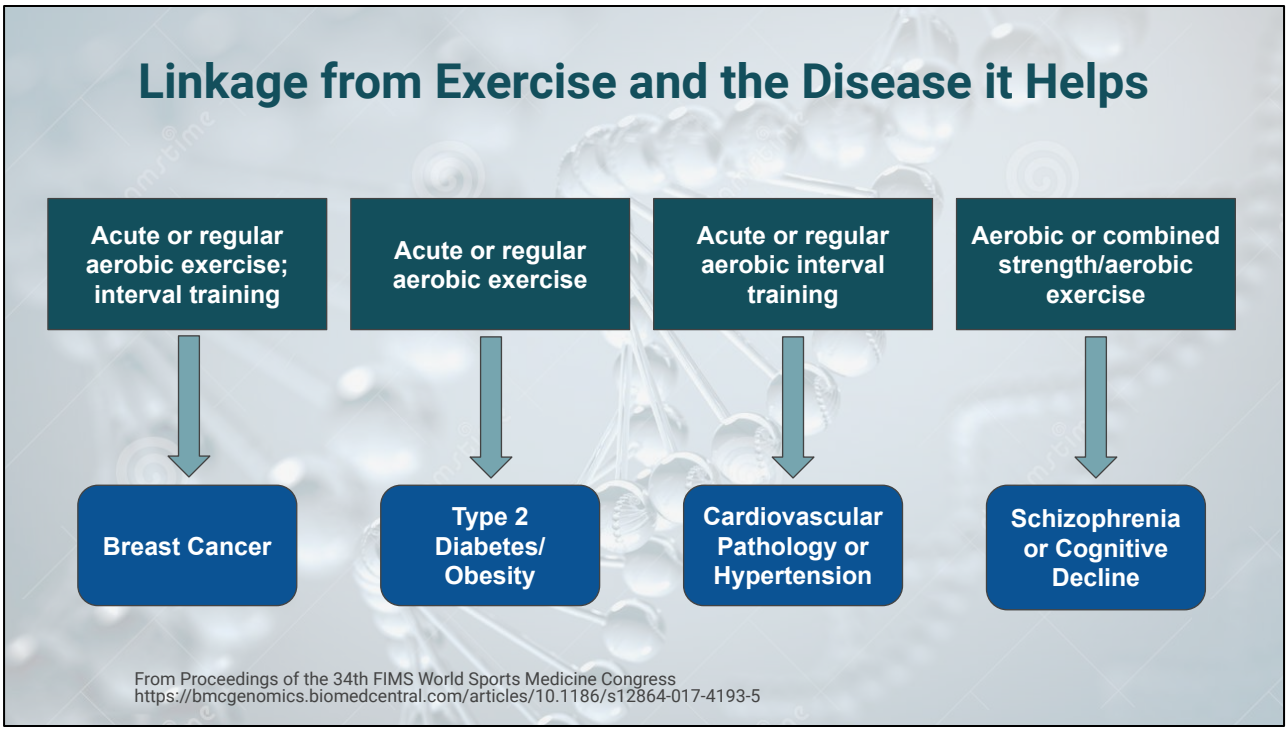

Has been shown to improve or completely reverse epigenetic suppression of:

- Tumor-suppressor genes
- Energy metabolism pathways
- Insulin sensitivity-related genes
- Mediators of the cortisol inflammatory pathway

What does the research say?

- Karolinska Institute in Sweden asked 23 men and women to bicycle using only one leg for 45 minutes, four times a week over three months. In comparing muscle biopsies before and after the experiment, scientists found that, in the exercised muscle, new patterns had developed on genes associated with insulin response, inflammation, and energy metabolism.

- Physical exercise has been shown to reduce and even reverse these epigenetic mutations, increasing expression levels of tumor-suppressing genes and decreasing expression levels of oncogenes. Hypermethylation in the promoter regions of tumor suppressor genes is thought to help cause some forms of cancer.



- Resistance exercise in humans induced epigenetic changes in pathways associated with **energy metabolism and insulin sensitivity**, contributing to healthy skeletal muscle. Endurance exercise also caused modifications in biomarkers associated to metabolic alterations through changes in DNA methylation and the expression of specific miRNAs. However, **both resistance and endurance exercise are necessary to obtain a better physiological adaptation** and a combination of both seems to be needed to properly tackle the increasing prevalence of non-communicable pathologies. (Specific Metabolic Alterations: A Systematic Review https://www.karger.com/Article/FullText/503289)
- Not able to give specific recommendations at this point of how much exercise is the right amount. One group believes that 12 weeks of low frequency, moderate intensity power training has significant ability to reduce the unnecessary methylation in elderly people.

Sleep

There isn’t much research that I could find about why sleep is so important. Theories include that our bodies repair our epigenome while we sleep, and if we don’t sleep enough, we don’t give our bodies enough time to fix themselves. The amount of sleep you need likely depends on your lifestyle and how much other support you give your body—or how much it needs to be repaired each night.

Meditation

Like with sleep, researches study the epigenetic effects of meditation are finding it difficult to establish a direction “site” connection. But this is what is known. Sleep ...

- Reduces cortisol levels (associated with stress)
- Stimulates anti-inflammatory compounds (cytokines, endorphins, neurotrophins)

Some believe that these effects change the epigenome in a positive way and actually decrease the expression of our stress genes and increase our stress suppressor genes.

- **Our intent can change the epigenome! My personal sources from the other side have indicated that with trained focus, we can change our epigenome. Temier agrees with that statement.**

(Nerd note: The analysis of human peripheral tissues (e.g., blood and saliva) has started to show that various types of meditation can reduce levels of the stress hormone cortisol and of reactive oxygen species (ROS), as well as stimulate anti-inflammatory cytokines, endorphins, and neurotrophins (Kasala et al., 2014; Pascoe et al., 2017). In addition, some authors have traced the effect of meditation on such effector molecules back to expression changes of the corresponding genes and, more recently, to specific mechanisms that regulate gene expression.)

(Thank you to Temier for allowing me to borrow profusely from the #124th Healing Gathering) ~8:00 minutes

Let's do a short mediation. Get comfortable and close your eyes.
Take four deep breaths. The first deep breath stills the body. The second deep breath focuses the mind. And the third deep breath allows the mind to go to the level of awareness that is perfect for this meditation. The fourth breath builds the group energy.

You find yourself in a large open meadow and you are quite aware of the elemental factors that surround you. You can feel the warmth of the sun, the solidity of the earth, the gentle breeze against your cheek, and you hear the sound of the ocean in the distance.

… And as you become more aware of these elemental factors, the sense of peace and well-being deepens. I am alone with the elements. There are no cares or disturbances or angers. I am at ease and I am comfortable. Let the shoulders droop and relax. And with the attunement to the elements and the sense of comfort you feel, every cell in your body relaxes.

The communication between cells escalates, and cellular awareness increases. Say quietly, but firmly to yourself, "**I allow every cell in my body to become aligned to its purpose**." Again. "**I allow every cell in my body to become aligned to its**

purpose."

And now take three deep, slow breaths. And with each breath the depth of your cellular awareness increases.

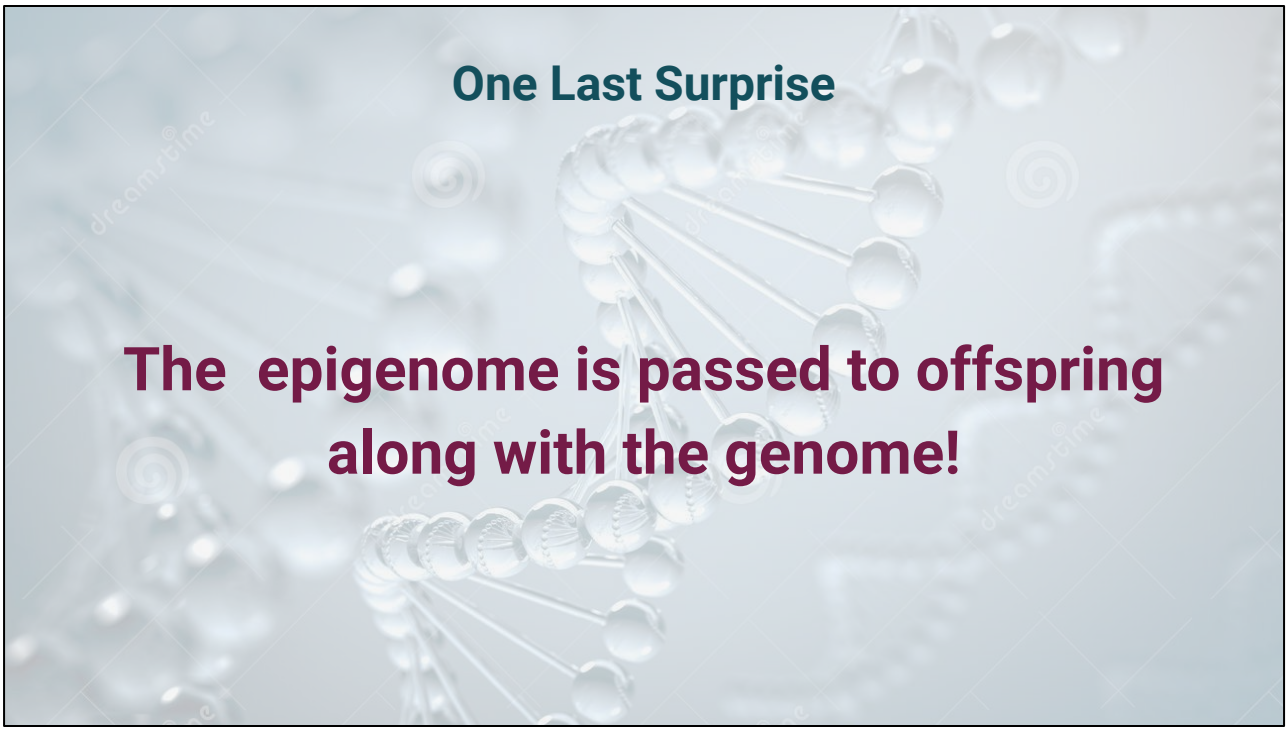
Breath 1: Each cell becomes aware of its individual purpose.
Breath 2: All similar cells within a single organ or function within the body become fully aware of that function.
Breath 3: Each system of the body becomes aware of all the other systems of the body, and they reach a point of perfect balance.

And through alignment every cell strengthens and greater health becomes. Each cell knows, understands, and becomes its full purpose. Each cell performs its function or responsibility within its organ or system perfectly. Take a moment to feel the difference in your body now.

I am in balance. I am strength. I am courage. I am able to walk my path in life <pause> and I accept the greater joy, the interaction, and the full purpose in my life. And with each of these statements the cells within you become better and better aligned.

From the point of light within me, my awareness and my purpose and the cooperation between cells becomes even greater. See that point of light and allow it to expand. Become filled with light. I am light. Sense it as it touches the tips of the toes and the fingers, and the top of the head. It completely fills you. I am light. I am love. I am peace. So be it.

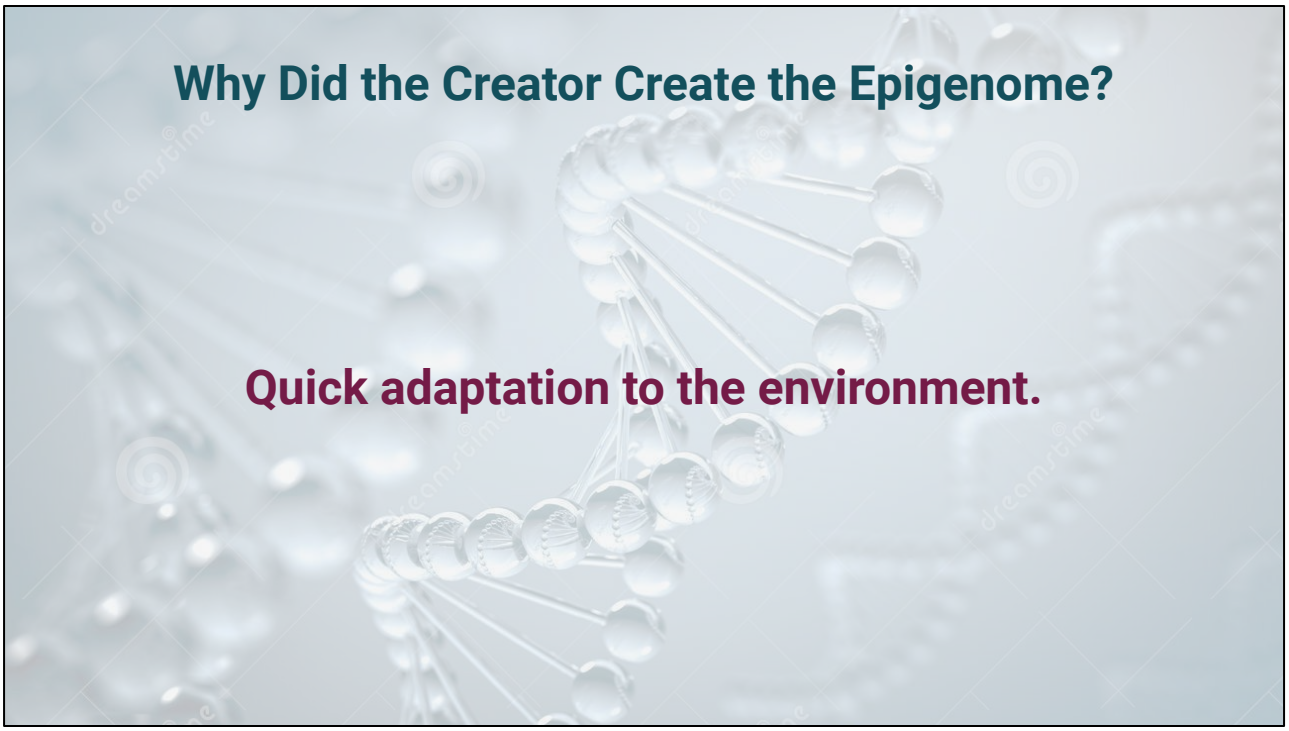
And when you are ready, gently return.



There is one last note that I wanted to make. There are now many studies that agree that we inherit our epigenome as well as our genes from our parents. So, what ever the state of our parents' health at the time of conception is pass on to us. This fact has all sorts of implications.

- One study suggests that the metabolic consequences of mom and dad's dietary habits can be inherited by their kids via epigenetic mechanisms, possibly setting them up for obesity or type 2 diabetes when they grow older.
- It has been noted for years that the children of holicaust survivors have the same psychological disorders as their parents despite never living under the same stress that caused the PTSD. It appears that the epigenome of PTSD is inherited. (Many studies about this.)
- The parent flies that were fed a high-fat diet began to develop the symptoms of lipotoxic heart disease, in which fat cells accumulate in the heart. This just confirms other research. But things got strange when researchers observed the next generation: The children and grandchildren of the #highfatdiet flies also experienced these symptoms, even on a lean-and-mean diet regimen.

  The study identified an epigenetic marker (if you must know, it's called **H3K27me3**) that made the next-gen flies more prone to fat-cell accumulation in the heart, which is a pretty scary concept. Who knew your double-bacon cheeseburger habit could potentially impact your grandchildren? Thankfully, the study also found that reducing the instance of this marker through dietary interventions protected future generations from this form of heart disease. So it's not all bad news.



I personally believe that the epigenome is an amazing creation by the Creator and friends:

- Our genes, for very good reasons, change at a very slow rate. In a hundred years, you might pass a gene on to 2 subsequent generations — so many 20 people at most. It would take many thousands of years to spread the new gene to a substantial number of people on the planet.
- So how do we adapt to our ever-changing environment? Different foods? Different toxins? It is our epigenome that allows us to make changes in weeks, maybe even days, to that we can keep up with the changes and survive as a species.

Any Last Questions?

If not now, you can contact me at

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