Epigenetics

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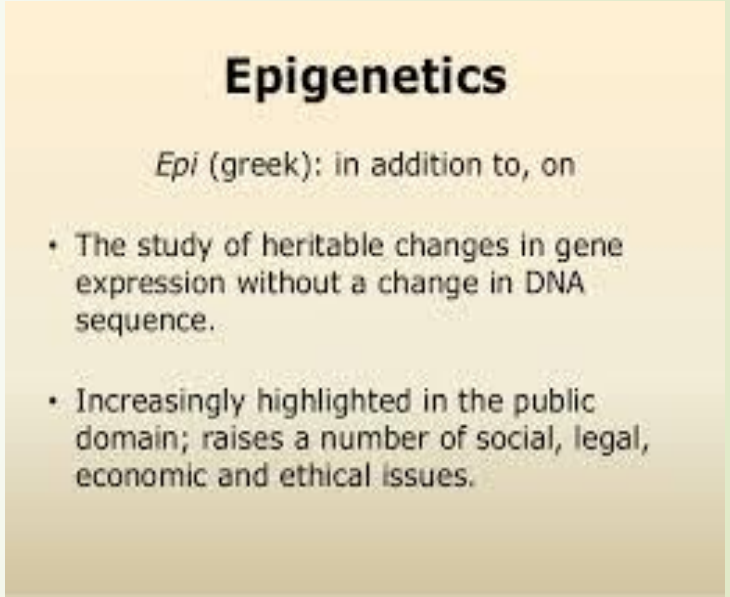
There is a voice that doesn't use words. Listen
- Rumi

Epigenetics

- These are exciting times.
- New science is enabling us to better understand what external and internal factors alter us.
- Our physical health, our emotional well-being, and our longevity are not only impacted by the hard-wired genetic code we inherit, but our genome is impacted by environmental influences to include as well as the way we live.



Definition please:

- Epigenetics literally means **"above" or "on top of"** genetics. It refers to external modifications to DNA that turn genes "on" or "off."
- These modifications **do not change the DNA sequence,** but instead, they affect how cells **"read" genes.** A very exciting trend in epigenetic research involves investigating the process by which our genetic tendencies are altered or influenced in their expression by outside exposure or stimuli.
- These epigenetic changes can last through **multiple cell divisions for the duration of the cell's life** but what is particularly compelling is that these changes may persist for **multiple generations** within our family line (Kain & Terrell, 2018).

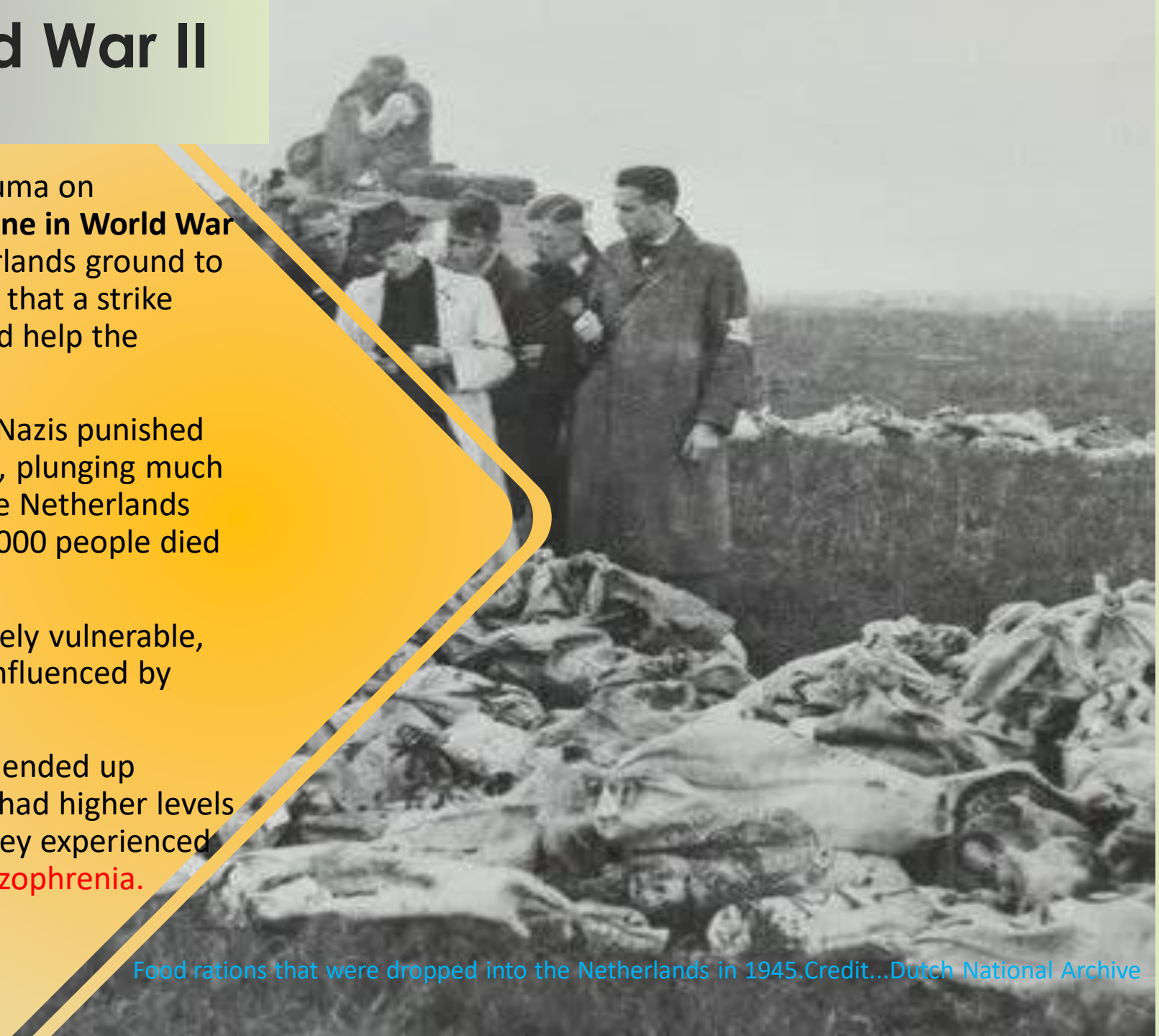
Trauma's Impact on Epigenetics

- Early trauma, for example, is one of the factors that can cause epigenetic changes and these changes can be passed on to the next generation and beyond.
- Researchers have come to appreciate that the horrors of the **Holocaust** did not only impact those who suffered the terror of the concentration camps.
- As one would expect, the survivors of the Holocaust often suffered from PTSD, but this did not stop there.
- Their children were more likely themselves to develop PTSD and other mood and anxiety disorders, whether or not they were exposed to traumatic events in their own lives (Yehunda et al. 1998).

Barbed Wire Clipart. The Holocaust ...clker.com

Dutch Famine in World War II

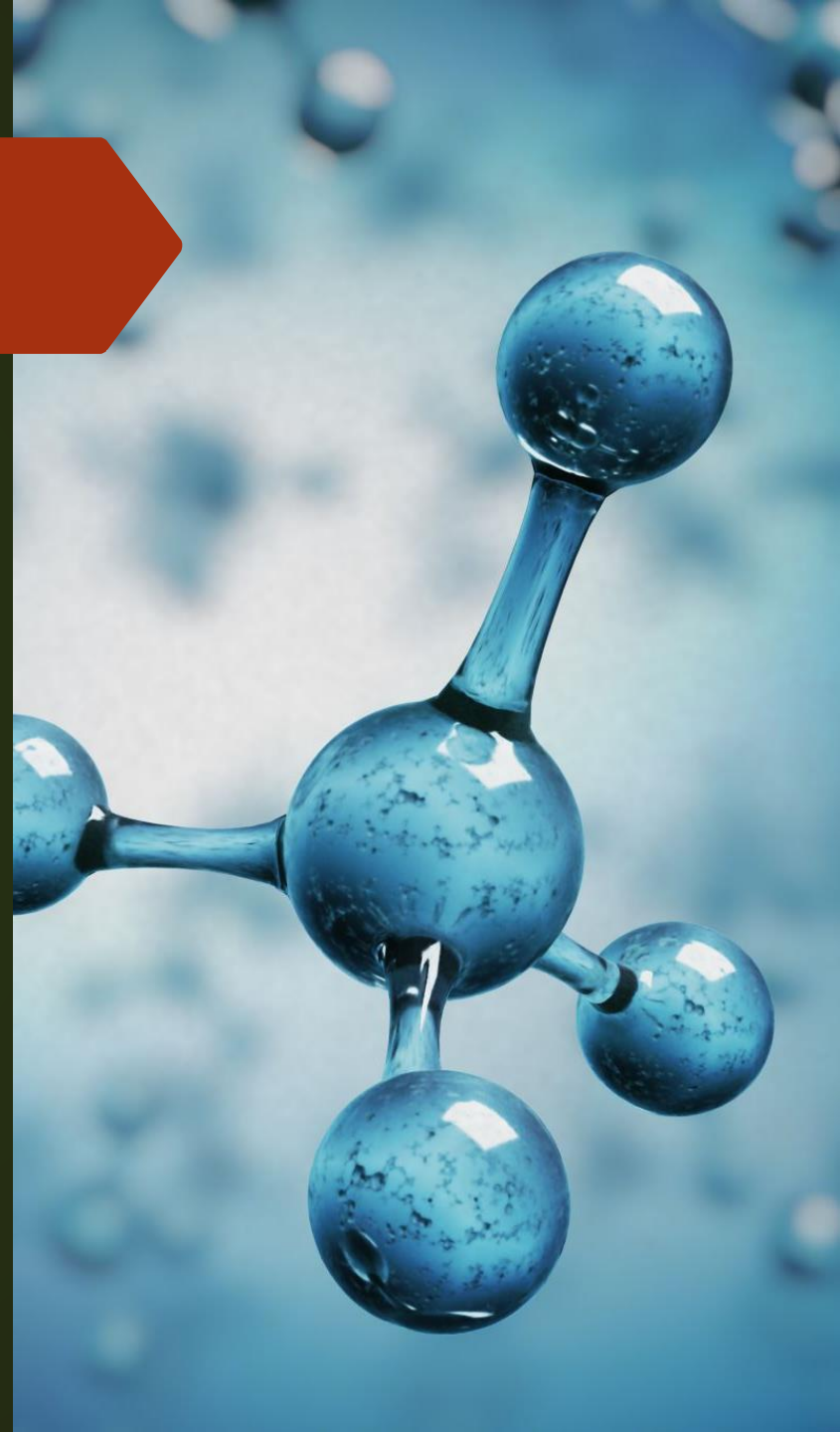
- Another sad example of the impact of trauma on subsequent generations is the **Dutch Famine in World War II**. In September 1944, trains in the Netherlands ground to a halt. Dutch railway workers were hoping that a strike could stop the transport of Nazi troops and help the advancing Allied forces.
- Sadly, the Allied campaign failed, and the Nazis punished the Netherlands by blocking food supplies, plunging much of the country into famine. By the time the Netherlands was liberated in May 1945, more than 20,000 people died of starvation.
- Pregnant women, it turns out, were uniquely vulnerable, and the children they gave birth to were influenced by famine throughout their lives.
- When these children became adults, they ended up heavier than average. In middle age, they had higher levels of triglycerides and LDL cholesterol and they experienced higher rates of obesity, diabetes, and schizophrenia.



Food rations that were dropped into the Netherlands in 1945.Credit...Dutch National Archive

For the science nerds among us:

- There are three primary mechanisms through which epigenetic changes in gene expression occur. But first a **biology refresher:**
- DNA from humans is made up of approximately 3 billion nucleotide bases.
- There are four fundamental types of these bases that comprise DNA: Adenine, Cytosine, Guanine, and Thymine, commonly abbreviated as A, C, G, and T, respectively.
- The sequence, or the order, of the bases is what determines our life instructions.
- There are about 20,000 genes in total. Genes are specific sequences of bases (parts of DNA) that provide unique and tailored instructions on how to make important proteins
- Proteins are large and very complex molecules that play many critical roles in the body and do most of the work in cells. Proteins are required for the structure, function, and regulation of the body's tissues and organs and are made up of hundreds and thousands of smaller units called amino acids.
- The sequence of amino acids is what determines each protein's unique 3-dimensional structure and its specific function. Proteins can be described according to their very large range of functions in the body to include: antibody, enzyme, messenger, and structural component.



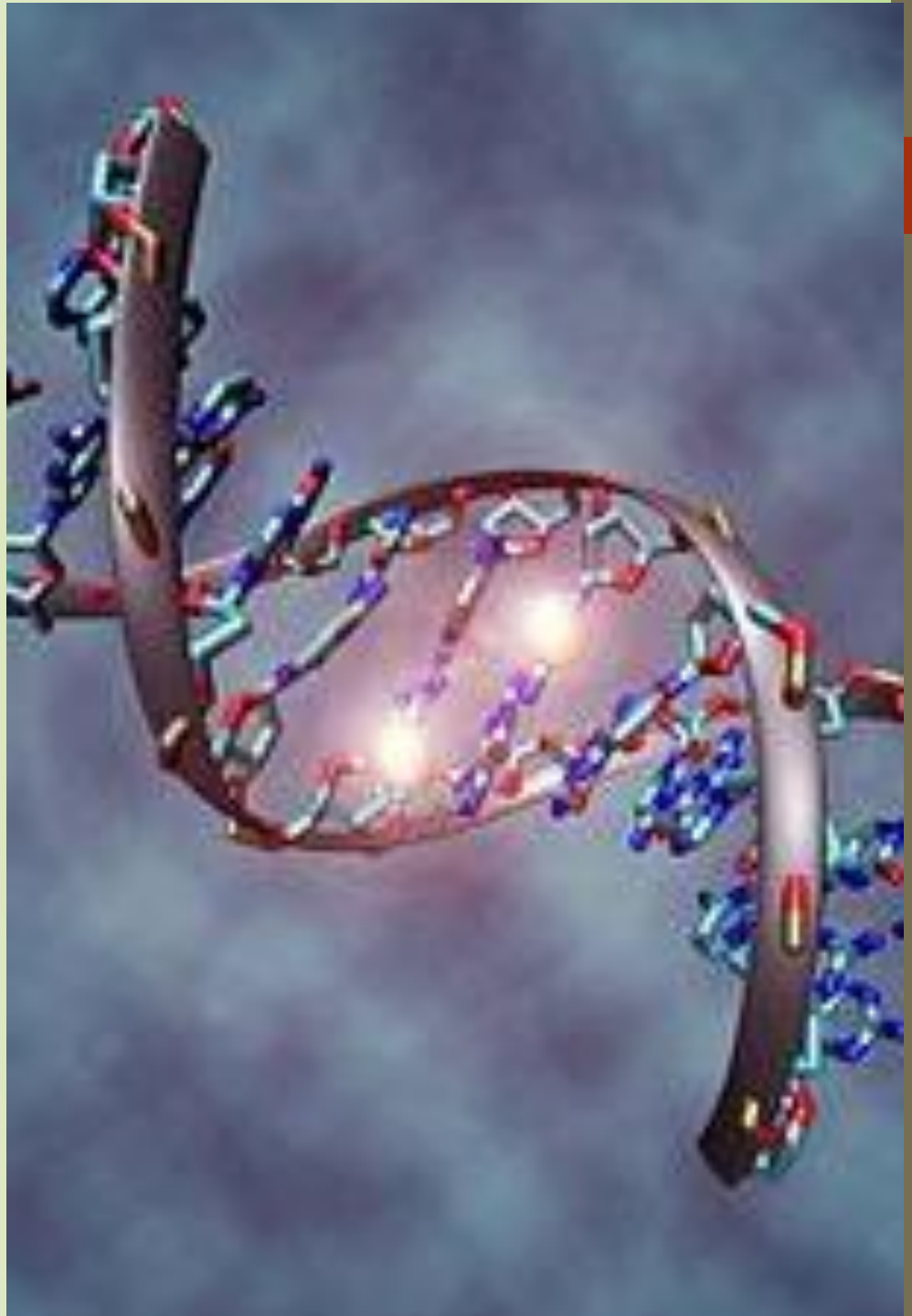
Epigenetic Changes – The Big Three

With that brief biology refresher out of the way, we can explore the three most well-known and best understood of several mechanisms through which epigenetic changes in gene expression occur.

As noted earlier, although a person's complement of genes or sequence of genes remains essentially the same from birth onward, except for the occurrence of mutations that can change the function of genes.

Different environmental exposures during development, diet, stress, emotional problems, etc., throughout a person's life chemically modify DNA and the proteins bound to it. In addition, individual's **histones**, or the proteins around which DNA winds when it is compacted into chromosomes, carry different chemical **tags** which are also influenced by environmental events.

These **tags** are thought to alter the extent to which DNA is wrapped around the histones, thereby affecting the availability of genes for activation. (Suitable my Nature, 2014; Fraga et al., 2005).



Epigenetic Changes – The Big Three

DNA methylation:

- The first type of epigenetic modification occurs on the DNA strand itself.
- This reaction, called DNA methylation, is a biological process by which methyl groups are added to the DNA molecule and thereby changes the activity of a DNA segment without changing the sequence.
- When located in a gene promoter, DNA methylation typically acts to repress or block gene transcription, effectively turning that gene off (University of Leicester, 2020),

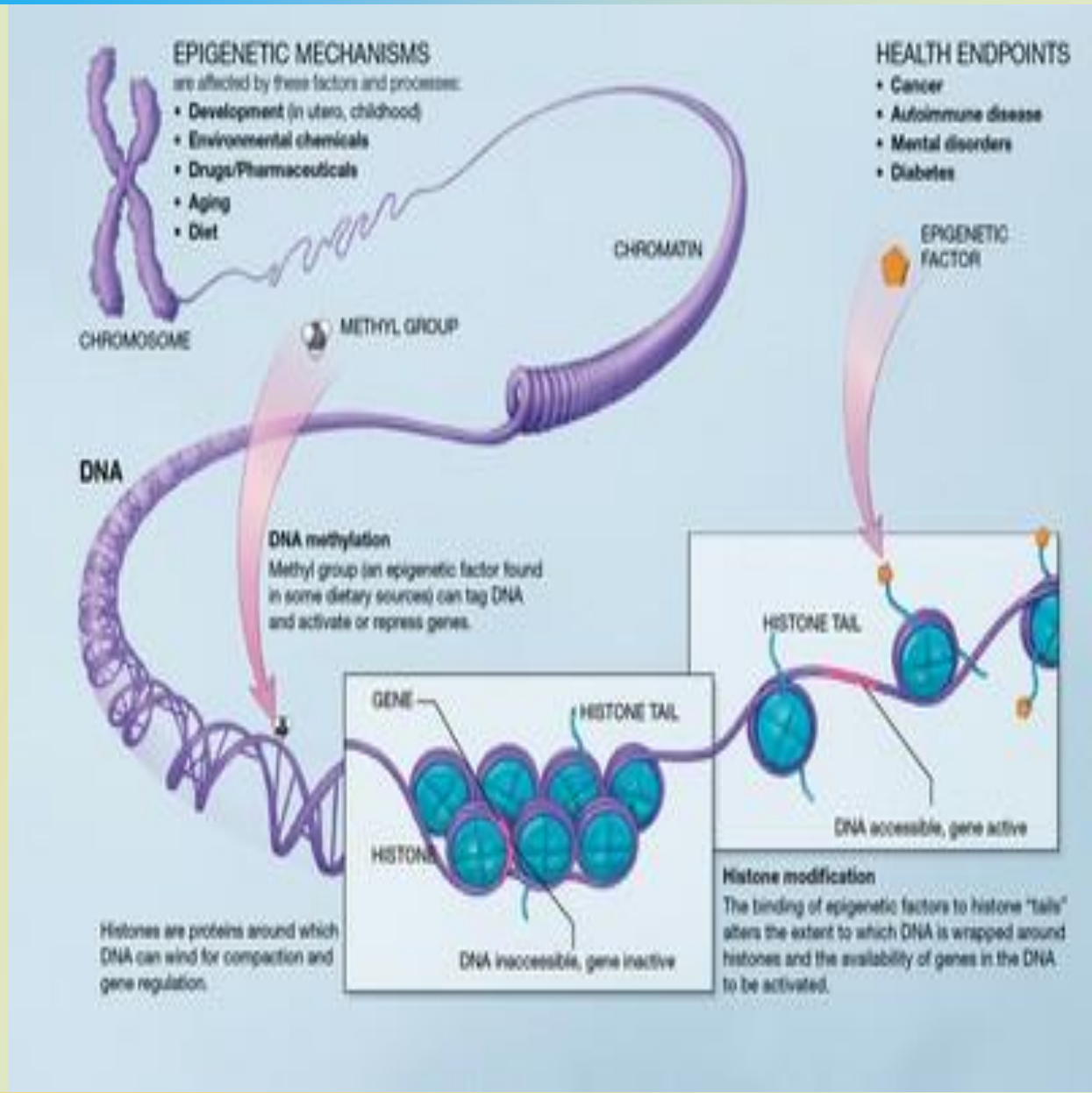
Epigenetic Changes – The Big Three

Histone modifications:

The second two types of modifications involve histones. Histones are the proteins that hold chromosome together. In histone modification, genes are actually wrapped up tightly so the genes cannot be accessed (essentially turned off) or unwrapped so they can be accessed or activated (essentially turned on). There are multiple types of histone modifications which are catalyzed by a number of enzyme families; the most well characterized modifications include acetylation and methylation:

Histone Acetylation is performed by *histone acetyltransferases (HATs)* which add an acetyl group to lysine amino acids (which are positively charged) in the histone tail which acts to mask the positive charge. This causes loosening of chromatin to promote gene activation (Strahl and Allis, 2000).

Histone Methylation can occur on lysine or arginine amine acids and can occur in mono-, di- or tri-methylation events by *histone methyltransferases*. This mark does not substantially alter the charge of amino acids and can be associated with both gene activation and inactivation (Laura,2008).



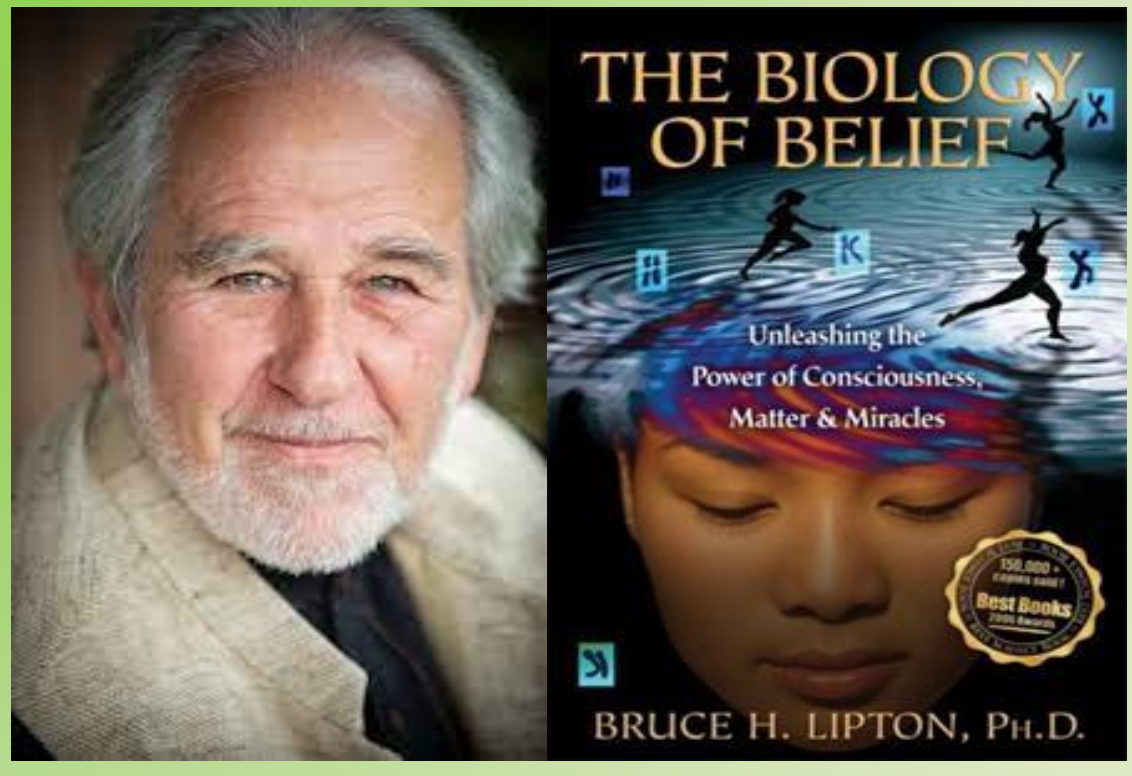
Epigenetics Takeaway

- Knowing about epigenetics is both scary and amazing at the same time.
- Terrifying in that we know that if we live poorly, paying little attention to how we live, i.e., the impact of poor diet, lack of exercise, living in stress, exposing ourselves to environmental toxins, overreliance on medications, etc., our genome will be altered, resulting in poor physical and/or emotional health and that this effect can be passed on to our progeny for generations to come.
- On the other hand, good choices bless us and our future generations. Bearing this in mind, we can appreciate more fully how discussions in the pages ahead about attachment, adverse childhood experiences, Polyvagal Theory, and disconnected living impact us in mind, body, soul, and genome.

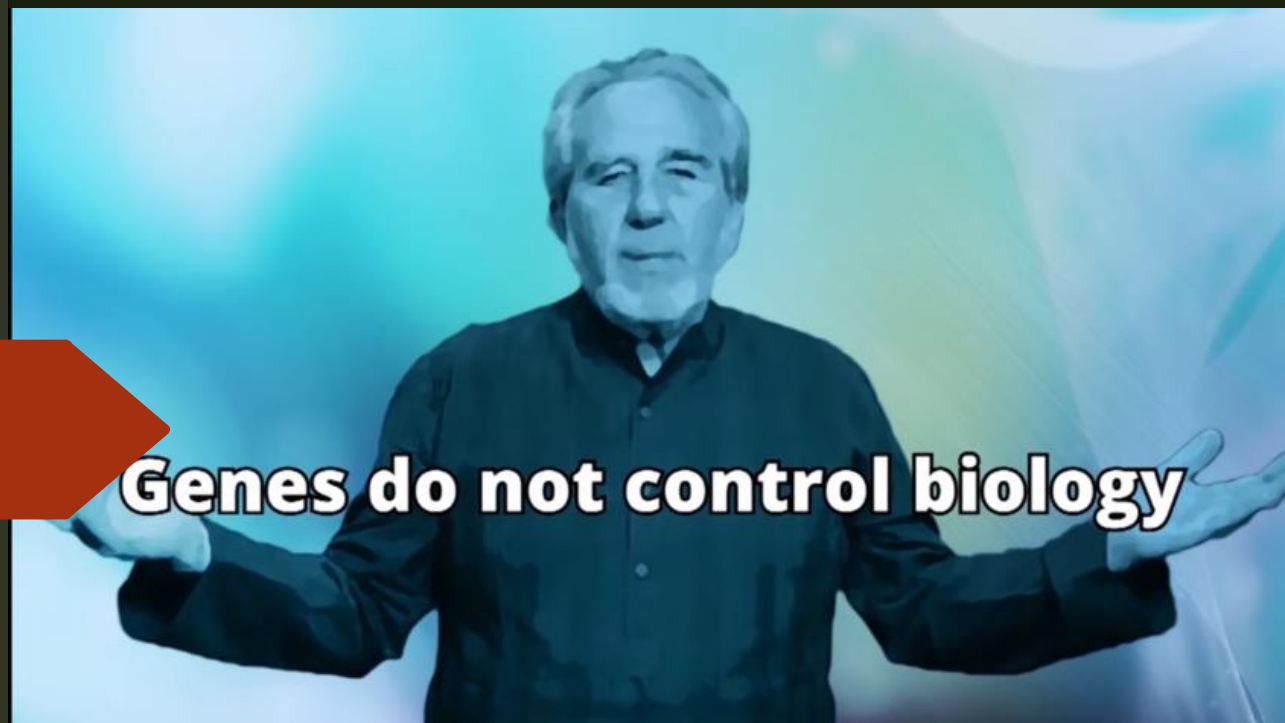
The following slides are largely modified from the brilliant cell biologist and medical school professor, Dr. Bruce Lipton, who gave the best talk on epigenetics I have ever had the privilege of hearing. He is also he author of the incredible book, Biology of Belief, which revolutionizes our understanding of the impact of how the way we live impact our health and challenges current medical perspectives that serve us poorly.

Please click here to list to the full lecture by Dr. Lipton:

https://youtu.be/qEYPCT-Rtrk



Dr. Lipton states that epigenetics make it clear that genes to not run the show



Contrary to common belief, genes control very little

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Blame Genetics?: 'Flawed Genes' Cause Less than 1% of All Diseases

by Elizabeth Renter

September 1st, 2013 Updated 09/03/2013 at 9:21 am

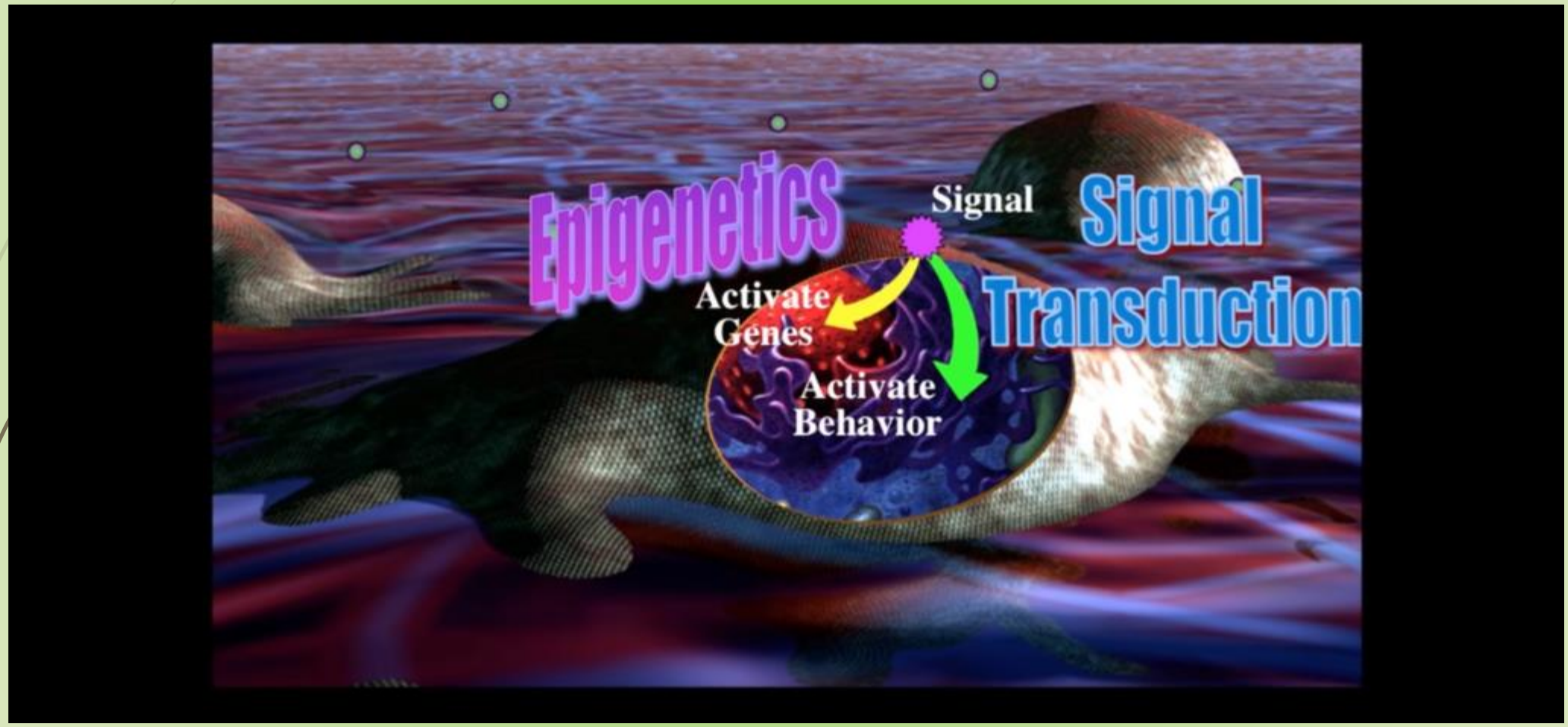
14

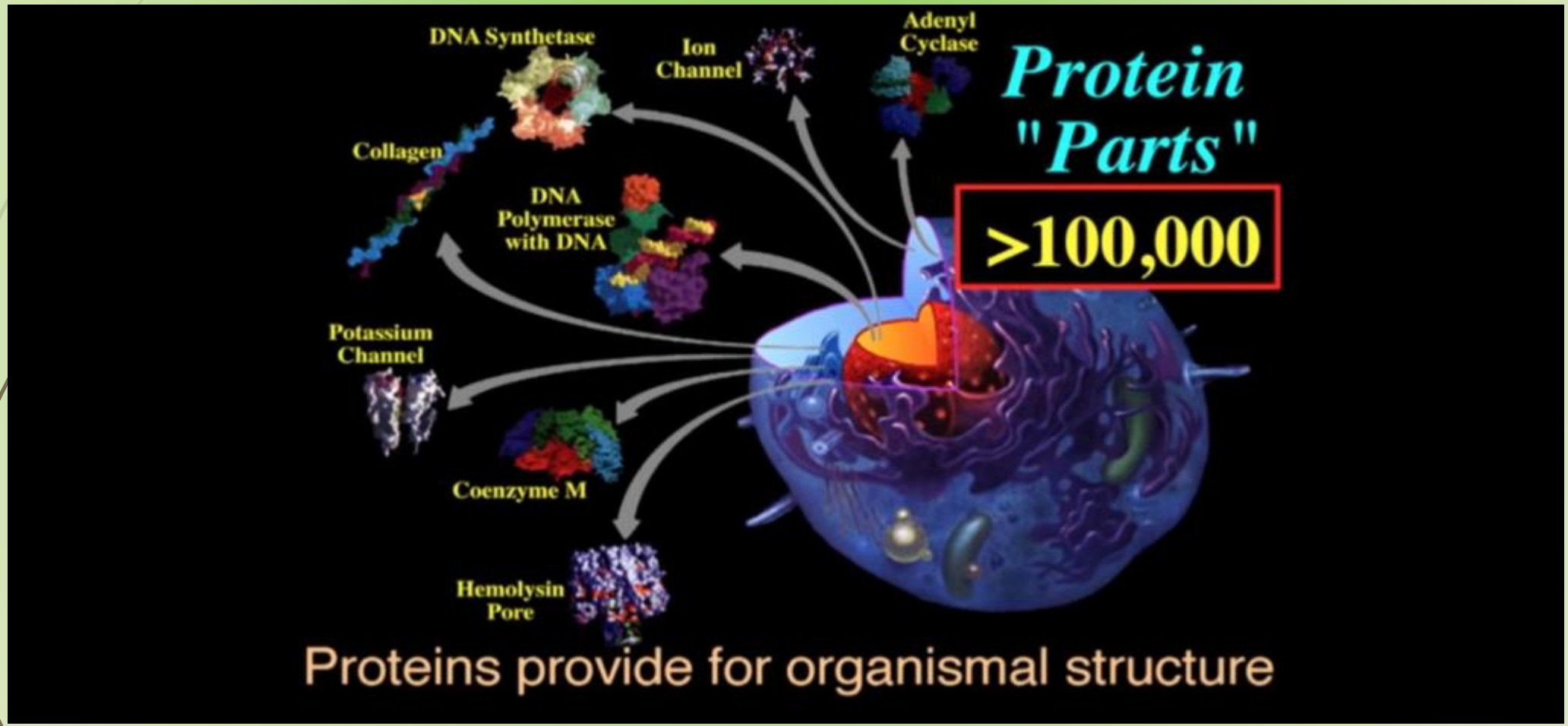
Obesity, diabetes, heart disease, and even cancer may very well "run in the family"—meaning it's a trend within your immediate ancestry—but our growing urge to call something inherited is not doing anyone any good. You see, the health concerns we often blame on our parents (or grandparents) are usually within our control. **As a matter of fact, it's estimated that less than 1% of all diseases are caused by flawed genes.**

The Human Genome Project, which effectively "mapped" the human genetic code, was completed in 2003. And in that project, scientists learned they were wrong about some things. One of those things was the number of genes in the human DNA. While they expected several hundred thousand—one gene for every protein, in essence—they found only 20,000 to 25,000.

As GreenMedInfo.com aptly explains:

> *There are not even enough genes in the human body to account for the existence of the basic protein building blocks that make it possible, much less explain the behavior of these proteins in health and disease states!*


Epigenetics
Signal
Signal Transduction
Activate Genes
Activate Behavior


DNA Synthetase
Ion Channel
Adenyl Cyclase
Protein "Parts"
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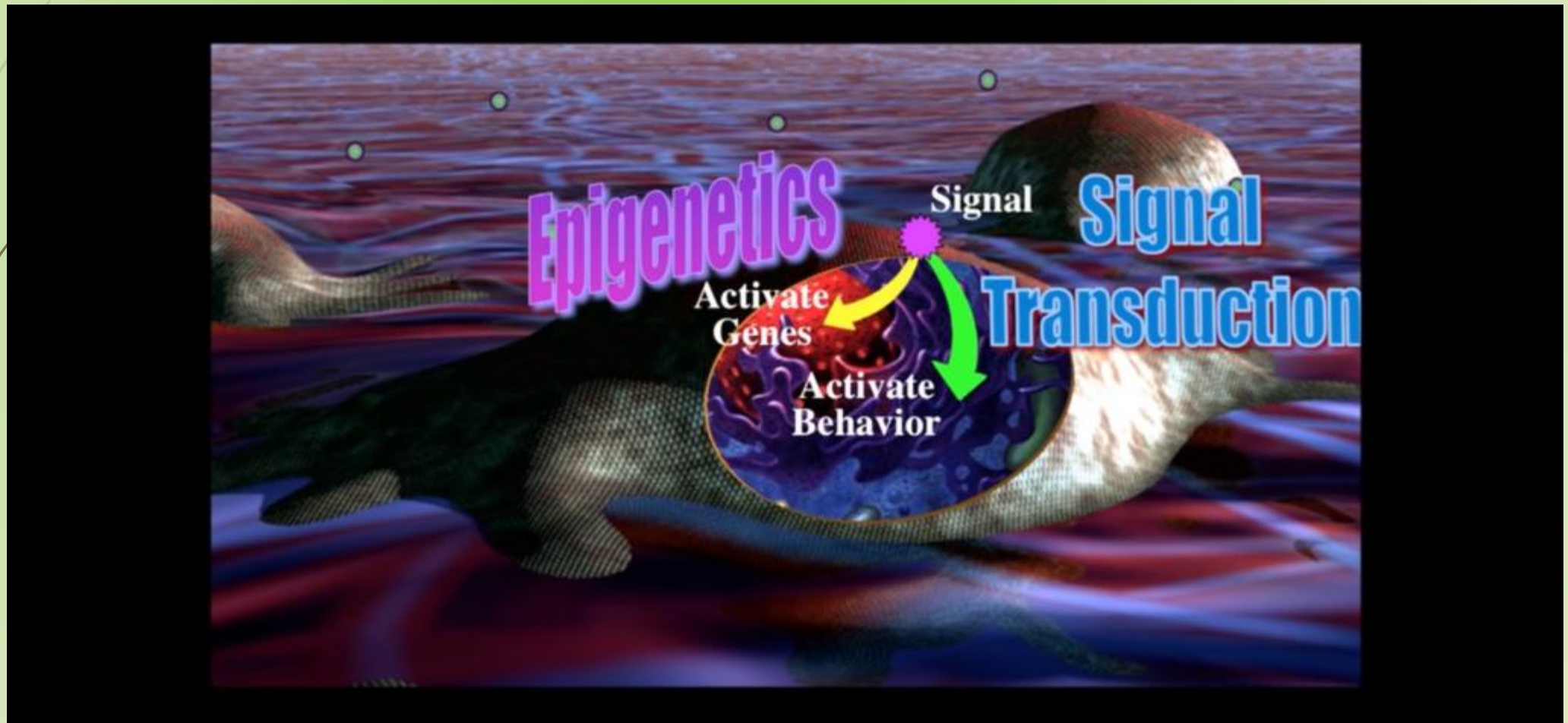
Collagen
DNA Polymerase with DNA
Potassium Channel
Coenzyme M
Hemolysin Pore
Proteins provide for organismal structure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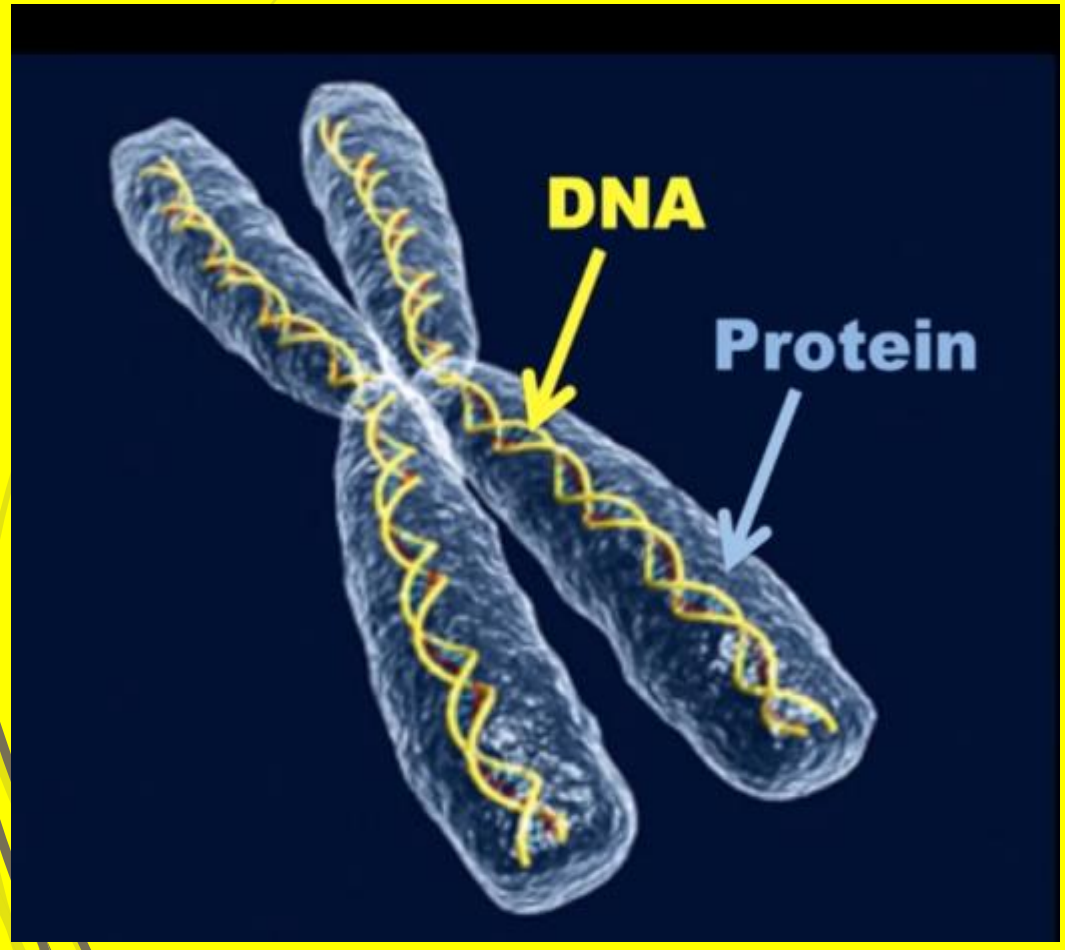
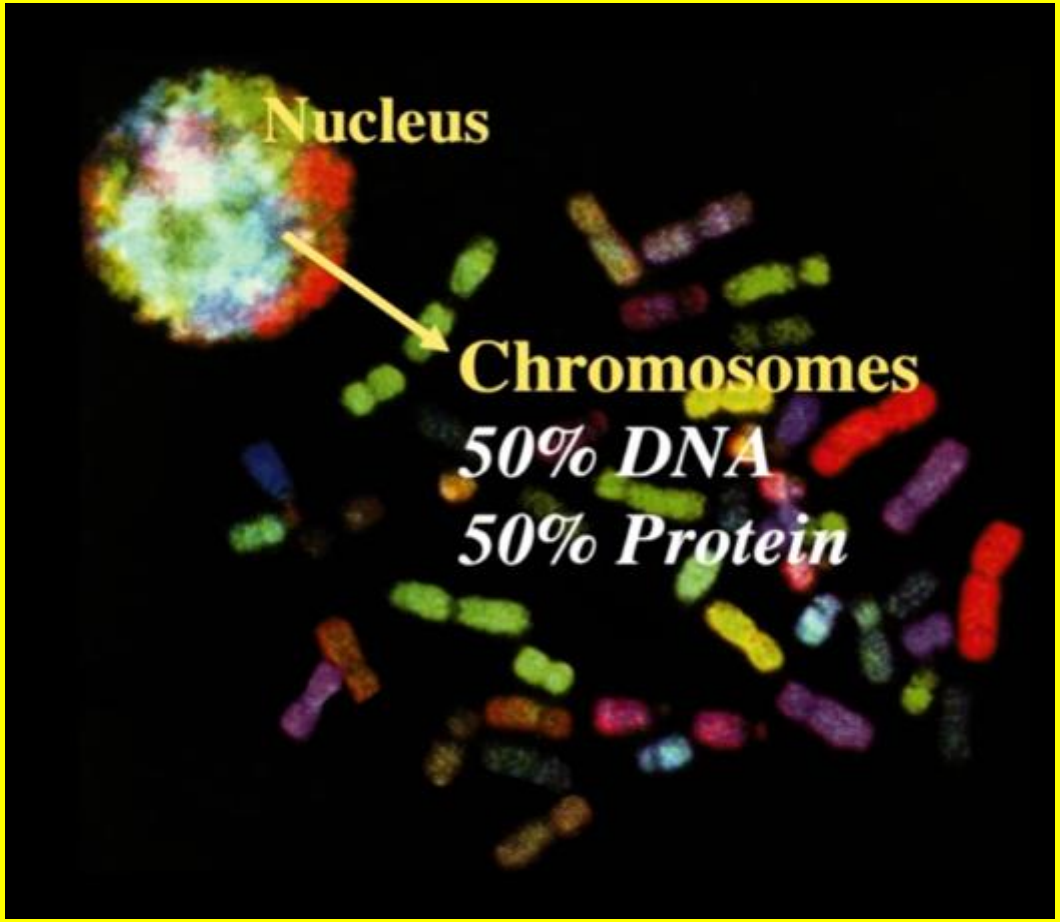
Chromosome Composition

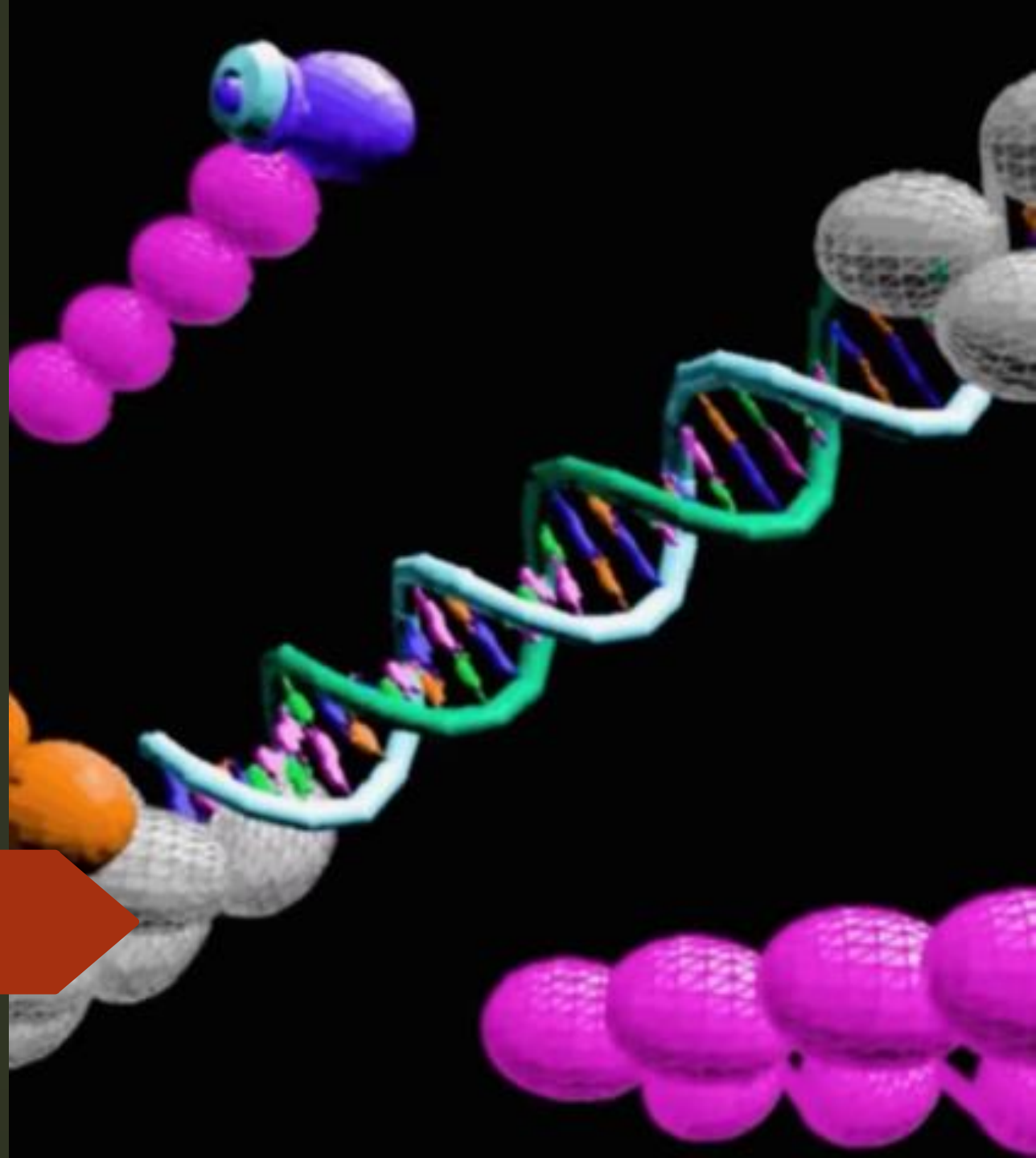
According to Dr. Lipton, most genetic researchers focus exclusive on the DNA in chromosome and throw away the rest. We know that a chromosome is comprised of 50% DNA ad 50% protein, and it is the protein that, as it changes shape, has profound impact on what genes are read and what genes are not read.



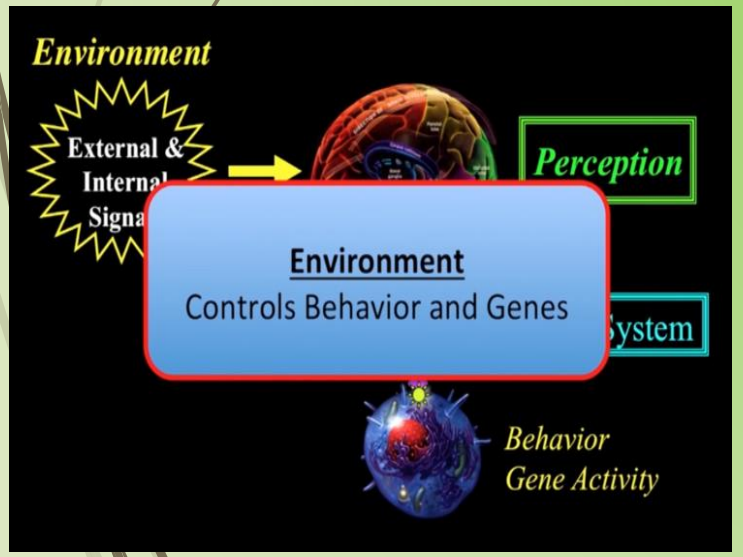


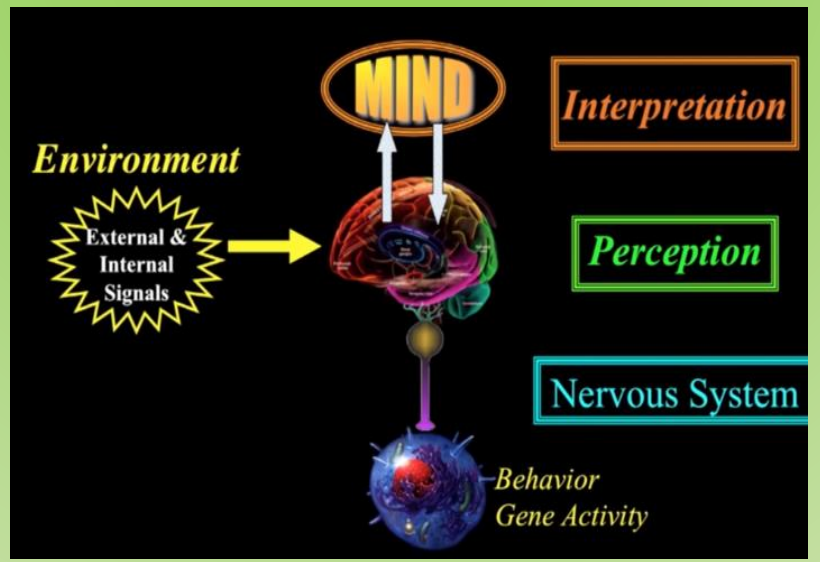
Reading Genes

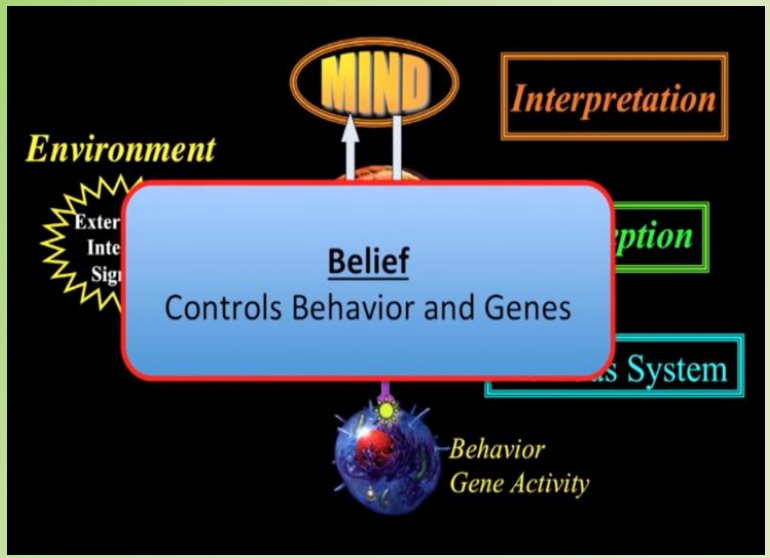
The graphic depiction show how the protein cover of the chromosome is removed so the genes in the DNA can be read. Epigenetic factors such as diet, toxins, and stress, help to determine this process. This can be good or bad in that genes that should be read are in fact so read or genes that should not be read are so read



Dr. Lipton asserts that it is environment (e.g., nutrition, stress, exercise, etc.) and belief (what we think and how we think) that control behavior and gene expression. So, the environment sends us both internal an external signals. We perceive these signals and via bi-directional exchange with body and mind there is an interpretation which impacts the nervous system and eventually gene activity.







Do Flawed Genes Control Most Disease?

Contrary to common belief, genes to do not control most diseases and this article, cited and endorsed by Dr. Lipton reports that it genes, in fact, cause less than 1% of all diseases.

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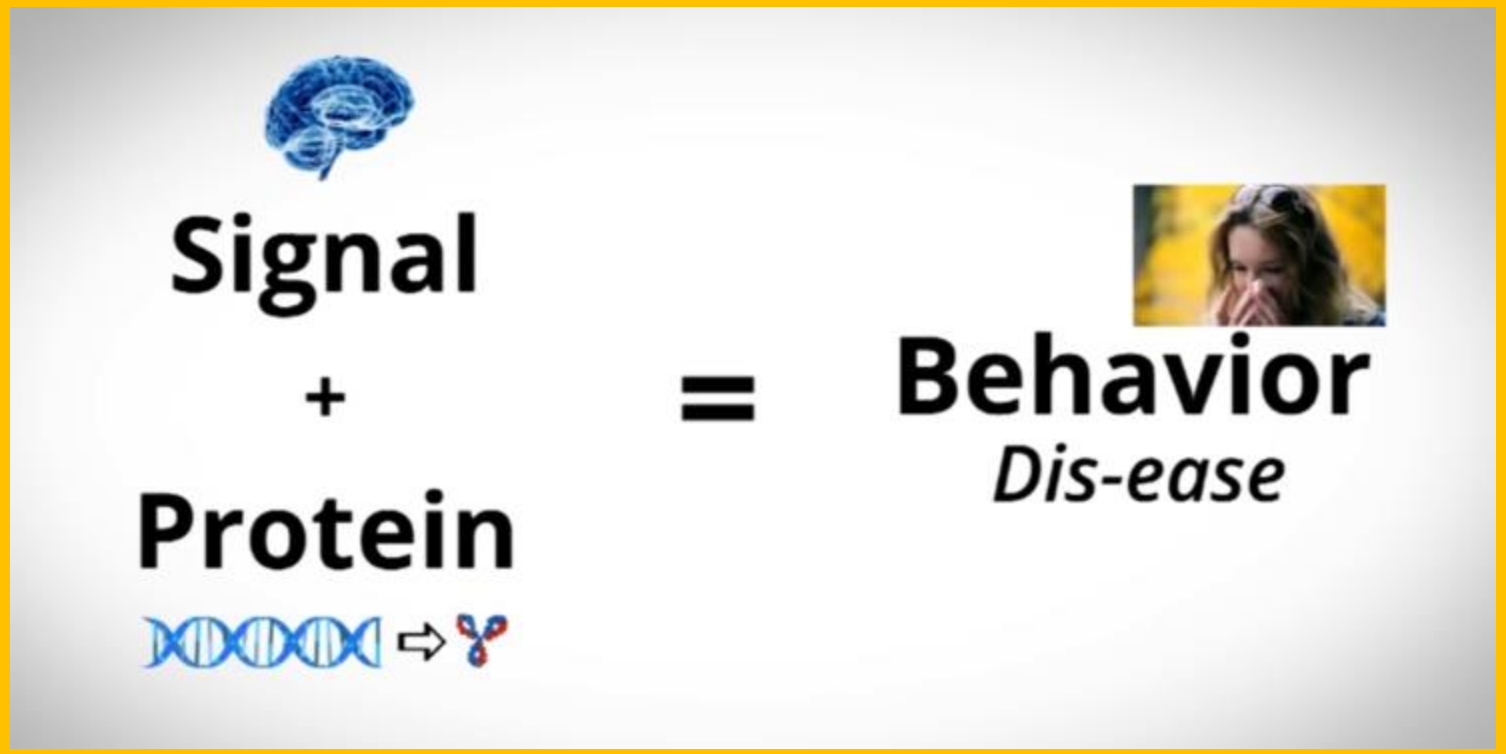
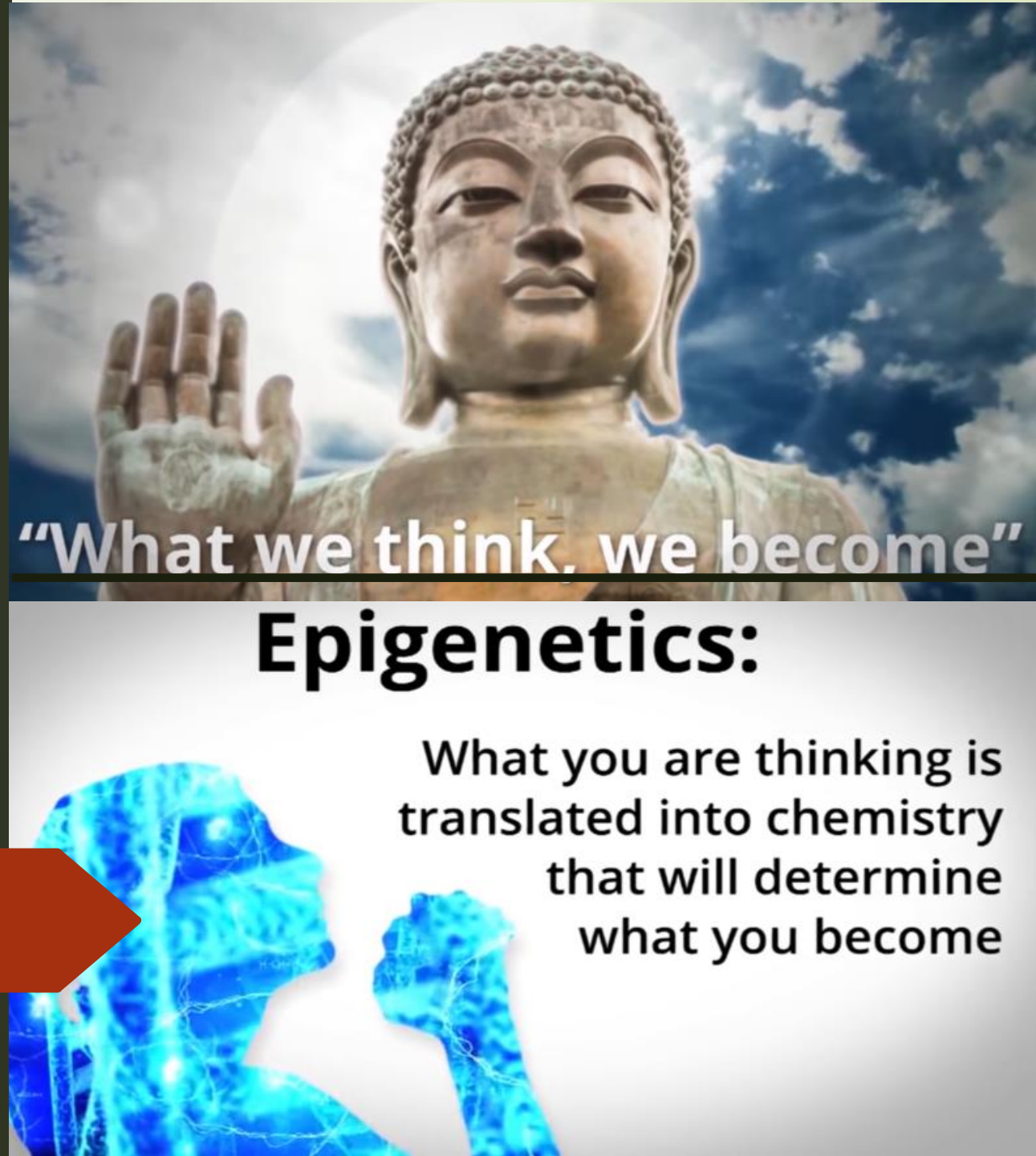
Signal

The negative signal impacts the protein that unlocks the genes of the DNA that are read which can result in negative behavior and disease.



The ancient Buddha had it right 25 years ago.



The perception of threat has an impact of about 1400 different biological processes in the body

Dr. Lipton asserts that there are three fundamental mechanisms that impact us epigenetically: