Epigenetics and the Epigenome

By Carlos Orozco
BSc, MSc, ND, MD, PhD, FPAMS
Scientific and Medical Director Cell Well Being

Traditionally speaking epigenetics is the study of heritable changes in gene expression that are not mediated through the DNA sequence but through the proteins found in the cell nucleus as well as those found in the cellular membrane (Lipton 2005)[1].

Molecular mechanisms that mediate epigenetic regulation include DNA methylation and chromatin/histone modifications that results in the non-expression of genes (Lipton 2013, Cheung *et al* 2005, Elgin 1996) [2-5]. Therefore, genes do not control our biology as it was originally believed. Moreover, we are not victims of our hereditary make up. With the identification of key histone-modifying enzymes, the biological functions of many histone posttranslational modifications are now beginning to be elucidated based on environmental signals and not on genetic determination (Van Steensel 2011)[5]. This means that our nutrition, thoughts, meditation, e smog (radiation emanating from electromagnetic frequencies), coming from electrical appliances that make our life very easy and convenient, play a major role in gene control through epigenetics.

The change in gene expression is mediated by our perception of the world around us, and it happens within hours. The epigenome is constantly influenced by these perceptions and signals from the environment. Therefore, histone methylation is of particular interest as it plays critical roles in many epigenetic phenomena[3].

When a protein called chromatin, found in the nucleus of our cells condenses, it gives rise to one set of genes that make up the body, another set of genes is found in the heterochromatin otherwise known as junk DNA (Roudier et al, 2011)[6]. This accounts for 98% of so called non coding DNA. This is so important, because it allows for the patterns found in our Biology and our behavior. The heterochromatin is very resistant to mutations, unlike the genes that are expressed through the reading of the genetic information by the ribosomes. Our life experiences are passed on from generation to generation through the epigenome.

The proteins are the ones that control the reading of genes and not the genes themselves. This is called epigenetics.

In Quantum Physics we now talk about harmonic resonance which deals with vibration between two or more waves which share the same frequency and amplitude and that are found in nature. One has an influence on the other, that means, the vibration travels across and from one to the other. We can send out vibration, through the process of our own magnetic brain activity. We become entangled with one another and the environment through this process. All of the sudden our brain frequency, thoughts and emotions are broadcasted out into what physicists called the quantum energy field. Our thoughts will recognize frequencies with the same vibration. Our thoughts will come back to us with the same vibration and they will be intensified and amplified by this reaction. This allows for reactivation of our own resonance, and it will intensify until it becomes our reality. And thus we get what we give, and we get more than we give. Sending positive thoughts will bring back positive actions and a positive environment. This is important since as negative thoughts for example, will bring back negative circumstances. Our thoughts influence everything around us. This is now known as behavioural epigenetics, originally baptized by Bruce Lipton as the Biology of Belief.

Memories are passed between generations via epigenetics. What our great grandparents ate, absorbed, thought and were exposed to, can be expressed in our epigenome, when the environmental signals allow for their manifestation.

Eating according to our epigenomic make up is now a reality. The S-Drive allows us to facilitate the decision making process of what to eat and what to avoid, in order to optimize our state of wellness and wellbeing.

Chromatin is found in two varieties: euchromatin and heterochromatin[4]. Heterochromatin is usually localized to the periphery of the nucleus. Despite this early dichotomy, recent evidence in both animals[4] and plants[5] has suggested that there are more than two distinct heterochromatin states, and it may in fact exist in four or five 'states', each marked by different combinations of epigenetic markers.

In summary:

The Epigenome:

- Allows for cellular differentiation
- Silence's some genes allowing for the expression of others based on environmental signals.
- It uses the process of methylation of histones and heterochromatin to allow for gene expression.
- Epigenetic nutritional food plans change genetic instructions.
- Allows for cellular Epigenetic Therapy by changing genetic instructions.
- The genome is inherited. The epigenome can be altered by environmental signals.
- Understanding and altering the epigenome allows for changes to expression which support wellness.

References:

1. Lipton Bruce (2005) The Biology of Belief. https://www.brucelipton.com/books/biology-of-belief
2. LiptonBruce(2013) http://brucelipton1.s3.amazonaws.com/member_call_with_bruce_december_2013.mp3
3. Cheung P, Lau P (2005) Epigenetic regulation by histone methylation and histone variants. _Mol Endocrinol Mar;19(3):563-73.
4. Elgin, S.C. (1996). "Heterochromatin and gene regulation in *Drosophila*". *Current Opinion in Genetics & Development* **6** (2): 193–202.
5. Van Steensel, B. (2011). "Chromatin: constructing the big picture". *The EMBO Journal* **30** (10): 1885–95.
6. Roudier, François; *et al*. (2011). "Integrative epigenomic mapping defines four main chromatin states in Arabidopsis". *The EMBO Journal* **30** (10): 1928–1938.

Appendix 1:

Evidence of the Epigenome influence is gene expression.

Embryonic development and differentiation produce organisms with many cell types whose identities are stably maintained over numerous cell divisions. Maintenance of cell identity depends on epigenetic control mechanisms that are linked to the assembly of specialized chromatin structures.

Genes that are located in silent heterochromatic DNA domains display variegated or bitable on and off expression states. These states, which are maintained during cell division, are examples of epigenetic states that result from changes in chromatin structure. Research in my laboratory is focused on understanding the mechanisms that are involved in the formation, function, and inheritance of heterochromatin.

Science. 2003 Aug 8;301(5634):798-802.

Heterochromatin and epigenetic control of gene expression.

Grewal SI1, Moazed D.

Abstract

Eukaryotic DNA is organized into structurally distinct domains that regulate gene expression and chromosome behavior. Epigenetically heritable domains of heterochromatin control the structure and expression of large chromosome domains and are required for proper chromosome segregation. Recent studies have identified many of the enzymes and structural proteins that work together to assemble heterochromatin. The assembly process appears to occur in a stepwise manner involving sequential rounds of histone modification by silencing complexes that spread along the chromatin fiber by self-oligomerization, as well as by association with specifically modified histone amino-terminal tails. Finally, an unexpected role for noncoding RNAs and RNA interference in the formation of epigenetic chromatin domains has been uncovered.

Danesh Moazed, PhD
Harvard Medical School
Biochemistry, Cell Biology

Glossary:

Epigenetics: The term epigenetics refers to heritable changes in gene expression (active versus inactive genes) that does not involve changes to the underlying DNA sequence; in other words, a change in phenotype without a change in genotype.

Phenotype: The observable physical traits or biochemical characteristics of an organism based on a combination of the organism's genes and environmental factors.

Genotype: The inherited genetic makeup of a cell

Epigenome: DNA modifications that do not change the DNA sequence can affect gene activity. Chemical compounds that are added to single genes can regulate their activity; these modifications are known as epigenetic changes. The epigenome comprises all of the chemical compounds that have been added to the entirety of one's DNA (genome) as a way to regulate the activity (expression) of all the genes within the genome. The chemical compounds of the epigenome are not part of the DNA sequence, but are on or attached to DNA ("epi-" means above in Greek). Epigenomic modifications remain as cells divide and in some cases can be inherited through the generations. Environmental influences, such as a person's diet and exposure to pollutants, can also impact the epigenome.

Chromatin: the readily stainable substance of a cell nucleus, consisting of DNA, RNA, and various proteins, that forms chromosomes and autosomes during cell division.

Heterochromatin: Highly condensed, tightly packed form of chromatin as opposed to the lightly packed euchromatin.

Euchromatin: A slightly packed or partially condensed form of chromatin that contains structural genes and is usually transcriptionally active.

Structural Gene: Any of the genes coding for the production of a specific RNA, structural protein or enzyme not involved in regulation.

Histones: Proteins that fold around the DNA.

Genetics: The science of heredity.

Gene: The fundamental, physical and functional unit of heredity.

Gene Expression: The translation of information encoded in a gene into protein or RNA structures that are present and operating in the cell. Expressed genes include genes that are transcribed into messenger RNA (mRNA) and then translated into protein, as well as genes that are transcribed into RNA, such as transfer and ribosomal RNAs, but not translated into protein.

Genetic Determinism: Mechanism by which genes, along with environmental conditions from the macro and micro cosmos, determine morphological and behavioral phenotypes.

Chromosome: A linear strand of DNA and associated proteins in the nucleus of eukaryotic cells that carries the genes and functions in the transmission of hereditary information.

Autosome: An autosome is a chromosome that is not an allosome (a sex chromosome). Autosomes appear in pairs whose members have the same form but differ from other pairs in a diploid cell, whereas members of an allosome pair may differ from one another and thereby determine sex. The DNA in autosomes is collectively known as atDNA or auDNA.

For example, humans have a diploid genome that usually contains 22 pairs of autosomes and one allosome pair (46 chromosomes total). The autosome pairs are labeled with numbers (1-22 in humans) roughly in order of their sizes in base pairs, while allosomes are labeled with their letters. By contrast, the allosome pair consists of two X chromosomes in females or one X and one y chromosome in males.

Harmonic Resonance: Harmonic resonance is an extraordinarily diverse and varied phenomenon seen in countless forms throughout the universe, from gravitational orbital resonances, to electromagnetic oscillations, to acoustical vibrations in solids, liquids, and gases, to laser resonance in light and microwaves. Harmonic resonance spans a vast range of spatial scales, from the tiniest wave-like vibrations of the elemental particles of matter, to orbital resonances that emerge from spinning disks of gas and stars.