What is a Genome?

A genome is all of the DNA in an organism, including its genes and a lot of DNA that does not contribute to genes. Each animal or plant has its own unique genome. Genetic DNA is the molecular code that carries information for making all the proteins required by a living organism. These proteins determine, among other things, how the organism looks, how well it adapts to its environment, and sometimes even how it behaves.

What is a Gene?

A gene is a discrete linear sequence of DNA which corresponds to a heritable trait. In more general terms, one can think of genes as the smallest unit of heredity. Analysis of the recently released Human Genome Project data indicates the human genome contains approximately 30,000 genes--only 10,000 more than a worm! Changing the DNA sequence of a gene changes the gene's function. Such changes are the basis for a variety of heritable traits including eye color and skin color. Unfortunately, small changes in the DNA sequence of a gene such as substitution of one base for another or omission or repetition of a small segment of the sequence can change the gene's function and result in a developmental or metabolic disorder. One goal of the human genome project is to learn more about these changes in the hope that genetic disorders might be understood and treated more effectively.

What is a Chromosome?

Most of the DNA is on structures called chromosomes. With a few exceptions, each cell in the human body contains 23 pairs of chromosomes. One chromosome of every pair is inherited from each parent. An individual human chromosome is made up largely of a tightly coiled double strand of DNA, some of which constitutes genes, but most of which (~98%) does not. The function of the non-genetic DNA is not yet known. After having been inspired by the artwork at the Genome project at the Block Museum, Northwestern University, IL. I began to think about these sequences , these amino acid sequences arranged as they seem to be in specific orders and patterns. The artistic representation really brought to life the notion of a linguistic string, a sequenced pattern that is coded and hidden within cells. The notion of metaphor that is used cross-disciplinary Moving from the literal reading of sacred texts to the hidden meanings also mimics this process. We look for gaps in the text, flaws in sequence, repetitions and misnomers, out of place characters and events and loss of flow of narrative in order to dig deeper into the text. In the very flaws of the text we dis-cover a deeper meaning a subtext that betrays the hidden text. Leah Ceccarelli has helped me understand and articulate the cross discipline metaphors and the way we can make use of them. "There is a set of common metaphors that appear and reappear in the discourse surrounding human genomics. The genome is often envisioned as the "blueprint" used to manufacture a human being. The metaphor of the "computer program" is also popular, with the genome as coded instructions to the hardware of the human body. Other metaphors compare the genome to different kinds of "text" (from an encyclopedia to a reference book to the Bible), to a territory that is being "mapped" by adventurous scientists, to a mysterious "code" that is being deciphered, or to a collection of order forms used by the cellular machinery of the human “factory." 'According to Abby Lippman, the blueprint, text, code and map metaphors contribute to the "ongoing process of geneticization in which differences between individuals are reduced to their DNA codes, most disorders and behaviors, as well as physiological variations are defined as at least in part genetic in origin and the adoption of interventions that employ genetic technologies to manage problems of health is advocated."

The fact that writers use mixed metaphors is not surprising. When the metaphors are as popular as these are, their figural nature is forgotten; readers are unlikely to even notice the incongruity of a thing that is simultaneously imagined as both substantial (territory) and immaterial (code), at once pictorial in nature (blueprint) and primarily textual (book). Alternatively, a metaphor that, on its own, would offer an oversimplification of the genome may be made more complex by its association with a complementary metaphor that adds another level to our understanding of nature.

Theorists describe the way in which metaphors work as an interaction between two terms the vehicle (that is, the metaphorical term) and the tenor (the subject you seek to describe with the metaphorical term). Each term has a set of ideas or commonplaces that might be called to mind when the term is taken in isolation; when the two terms are brought together, a set of associated commonplaces are invoked. This changes our understanding not only of the tenor, but also of the vehicle. For example, the metaphor "the genome is a blueprint" brings the tenor of "genome" together with the vehicle of a "blueprint." Not only is our understanding of the genome filtered through the screen of the "blueprint" vehicle (suggesting that the genome can be thought of as a visual representation of information, an orderly design, and something that provides instructions for construction of the human body), but our understanding of what a "blueprint" means is altered as well (for example, we are less likely to think of the way a blueprint follows certain conventions for representing doors and windows when we think of a "genetic blueprint"; that aspect of a blueprint is removed from our attention)." Ceccarelli suggests that there is also an interaction between two or more vehicles that are applied commonly to the same tenor.

"When the genome is modified by the "blueprint" vehicle, the genomes relationship to the "map" vehicle is different from what it would have been had the blueprint metaphor never been introduced. The tenor of the genome is irrevocably changed by the "blueprint" metaphor, as it is by the "map" metaphor, and, more importantly, by the interaction of the "blueprint" and "map" metaphors with each other. Like a blueprint, a map is a visual representation of information; it is orderly, and it offers instructions to those who use it. These aspects of a "map" are emphasized when it is connected to the tenor of "genome" and when that tenor enters our minds through the terministic screen of the "blueprint."

"Additionally, there are differences between these two vehicles that interact with each other to create a more complex understanding of the tenor than we might have had were either of these vehicles applied in isolation. While both maps and blueprints provide systematic accountings of data, the map brings order to something that presumably has an existence independent of the artist who draws it; in contrast, the blueprint offers an orderly representation of something that has yet to be built. While both maps and blueprints offer instructions to those who use them, maps give instructions for travel through a territory, while blueprints give instructions for the construction of something new. "Unfortunately, the "genome as text" metaphor interacts with another popular metaphor, the "genome as code" metaphor, to suggest that "reading" the genome is a much simpler affair than it really is. The "code" vehicle for DNA has a long history, becoming popular with Erwin Schrodingers comparison of DNA to "Morse code," with James Watson and Francis Cricks recognition that DNA was structured as a double helix in which each nucleotide base lined up with its complement, and with the subsequent "breaking of the code" that allowed us to recognize how particular sequences of three DNA bases were translated to particular amino acids. Extending these code metaphors, the Human Genome Projects sequencing of bases in the entire DNA complement of a human being is often referred to as a "decoding." This implies that a mystery is being solved or a secret is being revealed through the sequencing process. "Such a metaphor emphasizes the informational aspect of the genome, its linear structure, and the fact that

the sequence of nucleotide subunits must be known to understand its information. However, it also implies that one need merely list the sequence of "letters" in the code, mechanically transliterating DNA to the letters that represent each base, to be able to "read" the meaning of the genome.

When the vehicle of "code" interacts with the vehicle of "text," our attention is deflected away from the complexity of the relationship between genome and cell. After all, a text that is encoded should not require interpretation once it has been decoded. Once you know and apply the mechanism for decoding, the meaning of an encoded message is transparent. In the exhibit of Gregor Mobius when you walk in with the actual sequences plotted like the bible codes, I felt that here was a coded sequence of what we in science now consider an esoteric wisdom. No longer merely that which can be seen under the microscope, no longer that which can be imaged under MRI or PET Scanning, here was a hidden code that reflected a virtual kind of reality about life.

In Eastern medicine we are told of invisible charkas, meridians and other channels that have never been observed according to western empirical scientific method. Using the most sophisticated neurological diagnostic tools we have yet to correlate the acupuncture pathways with any specific neurological subsystem. I am wondering whether we too in the west have discovered a coding system that parallels this esoteric side of observable science. Just like kabbalistic metaphors, numerology and other decoding efforts applied to sacred texts to unearth a deeper reality are we not also exposing a similar hidden world of meaning in so-called western empirical science? If so what does this mean for our way of thinking about our patients and ourselves? This hidden esoteric dimension this code that subtends other codes, this met-sceintific language that will one day soon predict all sorts of futures such as predilection for Alzheimers, Parkinsons breast cancer and other hereditary diseases will alter the way we live and prepare for our medical future. This hidden secret encoded world then becomes an alteric reality that must be de-coded to make sense of our lives, for us to access an alternative reality a deeper sense of truth. When I listen to my patients, their lives and their suffering, I too must learn to hear this deeper message encoded.