First off I want to say, this is all new to the physical therapy world and especially to me. I will try to answer questions as best as I can. I think this is could be a very valuable part of the future of physical therapy.

Today, I am going to talk about Kinesiogenomics. Kinesiogenomics refers to the study of genetics in the various disciplines of the field of kinesiology. This field has also been referred to as “exercise genomics” or “exercisenomics”.

Areas of study within kinesiogenomics include the role of gene sequence variation, in other words, alleles, in sports performance, identification of genes (and their different alleles) that contribute to the response and adaptation of the body’s tissue systems such as muscles, heart metabolism, etc.) to various exercise-related stimuli.

**Why would genetic testing be valuable in the context of different environments for us as PT/PTAs?**

* Why some individuals are predisposed to disease?
* Why some individuals do not respond well to an exercise stimulus (or they respond very well)
* Predict sport performance or individualized exercise prescription
* Gene doping, which is the potential for genetic therapy to be used to enhance sport performance.

**Both the environment (what you do and what is done to you) AND your genetic make-up affect how your body will function**

**Review:**

* Genes that respond favorably to movement, exercise, load, length, environmental stress, and oxidative stress have been well conserved in humans for millions of years.
* There are approximately 23,000 genes in the human body.
* Genes are located on DNA then DNA is transcribed into RNA and RNA is translated into a protein and then that protein performs function in the body. There are more than 150,000 proteins in the human body .
* We all have the same genes, but slight different sequence variations that exist in a gene’s structure and can affect how that gene functions in the body. The letters that make up the spelling of each gene can be slightly different in different people, which can then influence when a gene is turned on, how much protein it makes, or how well the produced protein functions.

**OK now what does it mean to turn a gene on and off???**

Each cell expresses, or turns on, only a fraction of its genes. The rest of the genes are repressed, or turned off. The process of turning genes on and off is known as **gene regulation.** **Gene regulation** is an important part of normal development. Genes are turned on and off in different patterns during development to make a brain cell look and act different from a liver cell or a muscle cell, for example. Gene regulation also allows cells to react quickly to changes in their environments.

* Most commonly occurs at the level of transcription (when the information in a gene’s DNA is transferred to mRNA).
* Transcriptions factors bind to regulatory regions of a gene and increase or decrease the level of transcription. By controlling the level of transcription, this process can determine the amount of protein product that is made by a gene at any given time.
* FOR EXAMPLE: There may be times when you are just not seeing results and can sometimes be caused by the atrophy gene has been turned on and we cannot get it turned off. Knowing how to optimally “turn off” and “turn on” certain genes will form the basis for precision physical therapy in the future.
* When we repetitively suppress or “turn down” a healthy gene by disease or reduced movement, we enhance a process called “methylation” and accelerate the age of tissues. The overall aging clock of humans can now be estimated by a blood test to determine a methylation score—estimating how many healthy genes are getting turned down as a function of age, injury, immobility, or disease. It is our role as physical therapists to prescribe interventions that turn these healthy genes back on to extend the life of the cells.

I watched a Mary McMillian lecture from 2017 presented by Richard K. Shields, PT, PhD called **Turing over the Hourglass.** He has contributed to the physical therapy profession as a clinician, scientist, professor, and department executive officer of the Department of Physical Therapy and Rehabilitation Science at the University of Iowa. Dr. Shields is hopeful that genomics will become a useful tool for us in the profession of physical therapy.

* He believed we as clinicians can change time for our patients. We can turn over the hourglass for them. We can give our patients a new lease on life.
* He stated that our interventions if appropriately prescribed and adhered to are powerful regulators of genes that activate the energy systems that can reduce the rate that cells and tissues age.

**PCG1-Alpha- Peroxisome proliferator-activated receptor gamma coactivator 1-alpha.**

* Is a protein that in humans is encoded by the PPARGC1A gene
* PCG1 regulates the health of the mitochondria. We must protect the energy generating centers of the cell.
* Because we are made up of activity-regulated genes, the mitochondria malfunction when we experience reduced movement.
* PGC1 alpha promotes mitochondrial replication and function, telomere length preservation, and epigenetic tagging of metabolic genes.
* With regular movement, the PGC1 alpha becomes perpetually upregulated, developing a “molecular memory.”
* A repetitive healthy environmental stimulus, like movement—that promotes a gene that improves health and holds that promotion in memory—is the field of epigenetics. The epigenome oversees the genome and is relevant to physical therapists because our treatments are repetitive and typically prescribed for long time periods. When the epigenome “tags” a healthy gene to promote it, like the PGC1 alpha gene, there is a “protective memory” that enhances cellular energy function even if you suddenly have a period of unexpectedly reduced activity
* So, if the dose of activity that we prescribe for our patients promotes the PGC1 alpha gene and subsequently preserves telomere length, reduces methylation, and reduces blood glucose levels, then we should be optimizing the potential to decrease the mortality risk for people with compromised movement.

**What can we as physical therapists and physical therapist assistants take away from this?**

* Frequent movement is therefore an important strategy to promote the expression of healthy genes and repress the expression of genes that can damage tissues at any time during life.
* Each one of our patients can respond differently to selected interventions, but with the study of genomics and physical therapy combined, we could have a better understanding of why and how a patient is responding to a specific intervention and also for preventative measures.
* We are approaching a day when many of our patients will have their own PMP-personalized molecular profile, providing the biological predictors of cellular health.
* We must visit the macro-scale world of the human experience with a focus on our patients and our students. In the end, Dr. Shields hopes to challenge you to think about the future that we embrace as physical therapists and physical therapist assistants.
* We must appreciate the inherent differences that exist within our patients. People living with disease, injury, and/or immobility experience individualized genetic changes that affect their ability to respond to our treatments. The intensity and duration of our movement dose is rarely a “one size fits all.”.
* Molecular surveillance will be a key method to classify and justify a more precise physical therapy interventions.
* Genome-based prediction rules are on our horizon.