### 0.1 | #flo #ret

# 1 | Notes

### 1.0.1 | Overview

- Organisms turn genes on and off which is called Gene Expression
  - This can be done in response to external and internal signals
    - These signals are based off of environmental factors
  - This is also be done in order to specialize cells
    - Certain cells need certain genes to preform their specific role

### Differential Gene Expression

- Human Cells can express about 20% of it's protein coded genes at any given time
- Most cells contain the same genome
  - Each cell type must use specific parts of this genome
    - This is called Differential gene expression
  - Exception would be cells of the immune system
- Due to the importance of gene expression when it has issues it can affect the organism significantly
- Process of Gene expression in a Eukaryotic cell
  - Chromatin (DNA unpacking) –>
  - RNA processing –>
  - Transport to cytoplasm –>
  - Translation –>
  - Protein processing –>
  - Transport to cellular destination–>
- This process can often be equated to transcription for Prokaryote cells

### 1.0.2 | Regulation of Chromatin Structure

- The chromatin structure itself allows for the regulation of gene expression
  - This is partially due to the location of the promoter
- Chemical modifications to the histone proteins can affect the structure
  - This in turn can affect gene expression
  - Histone proteins are the proteins in which the DNA is wrapped
  - There are many types of modifications that can take place
    - Histone acetylation can tend to promote transcriptions by opening up the chromatin
    - Additional methyl groups tend to close up the chromatin and decrease transcription

  - DNA methylation occurs in most plants and animals as well as fungi
  - Methylated DNA will stay methalated through cell divisions
    * This accounts for genomic imprinting
    * These epigenetic markers can be inherited
      · There is continually more evidence for the importance of epigentics in gene expression ### Regulation of Transcription

- Chromatin changes are not permanent and can be reversed
- The next step of gene expression regulation is in the transcription factors
  - These either allow for or inhibit transcription
- These factors usually bind to proteins, but some of them bind to DNA
- High levels of transcription factors created for specific genes are associated with another protein thought creatively of as specific transcription factors
- Gene expression is dramatically increased or decreased by the binding of specific transcription factors
  - These are either activators or repressors
- There are many transcription factors
  - Repressors act in many different ways, but some bind directly to control element DNA blocking activator binding
  - Others interfere with the activator itself
- Coordinated control of genes can need to happen when multiple genes need to be expressed at the same time for something to function
  - These can often be signaled from the outside with something like a hormone
- The activation of receptors on the surface of the cell can release specific repressors and activators

### Mechanisms of Post-Transcriptional Regulation - Transcription is not the only thing that regulates gene expression - How much of the protein is created once the RNA is received is also a factor - RNA can be interpreted in different ways with different things being introns and others being exons - This allows for the creation of multiple proteins from the same strand of RNA - RNA splicing is critical since it allows a lot of information to be fit on a single strand of RNA - Around 75-100% of human genes with multiple exons undergo RNA splicing allowing for our genome to describe a lot of complexity without needing as many genes - Translation is another stage at which gene expression occurs - Some regulatory proteins can bock translation of an mRNA by preventing attachment to a ribisome - Length by which an mRNA is around is also crucial - This can vary greatly depending on the cell - Cells can mark proteins for destruction using something called ubiquitin