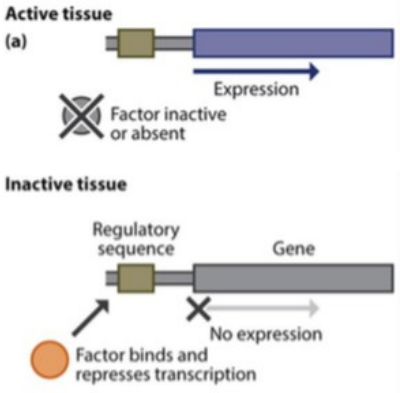
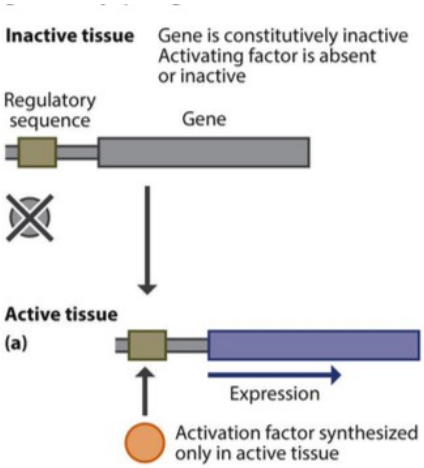
Chapter 2 : Structure of Chromatin

Regulation of transcription in eukaryotes is much more complex than in prokaryotes

Prokaryotes	Eukaryotes
Genes are generally "on" by default and have to be repressed to switch them off. Controlled by negative regulatory mechanisms -**Repressors**	Most genes are "off" by default and need activating factors to activate transcription Controlled by positive regulatory mechanisms –**Activating factor**
Cells do not commit to a differentiated state	Cell lineages commit to a differential state early on
Long term regulatory processes (eg chromatin state) are less influential	Interplay between short term transcriptional responses and long Term regulatory programs





Short term and long term regulation in Eukaryotes

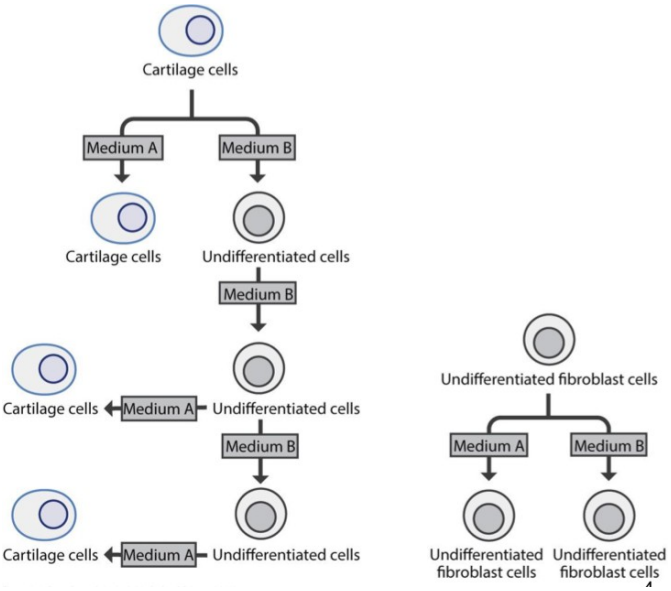
- **Short term (activation of gene transcription):**
  - Reversible
  - Regulatory events to quickly turn gene sets on or off in response to changes in the environment (eg enzymes, stress, etc.)
  - Proteins interact transiently with DNA control elements
  - Transient changes occur in chromatin structure
  - Found in bacteria too
- **Long term (regulate chromatin structure):**
  - Semi-irreversible
  - Permanent changes in chromatin structure
  - DNA methylation

- Cells are 'committed' to a particular cell type-once committed the cell type shows stability and is not changed to another type
- Long term changes are different between cell types

2.1) COMMITMENT TO THE DIFFERENTIATED STATE AND ITS STABILITY

Cells can remain committed to a particular differentiated state even in the absence of its phenotypic characteristics

- Cells must be capable of maintaining their differentiated phenotype throughout their lifetimes
- Long-term control processes ensure that the cells maintain their differentiated state and 'remember' their cell type even under conditions where they cant express the characteristic phenotype of the cell type.
- **Cartilage cells:**
  - Possible to regulate behaviour by changing the medium they are placed in
  - In medium A: produce cartilage-forming colonies synthesizing chondroitin
  - In medium B: Rapid division is favored and all specific characteristics of cartilage cells are lost. Become indistinguishable from undifferentiated fibroblast-like cells.
  - After many cell divisions in B, the cells can resume the appearance of cartilage cells and synthesize chondroitin sulfate when returned to medium A – Undifferentiated fibroblast cells don't do this.
  - Cartilage cells have an inherent memory of cell identity



Cells can become committed to a particular differentiated state before actual phenotypic differentiation

- Cells belong to a specific lineage and commitment mechanisms exist