

# CHAPTER 8 : GENE CONTROL AND CELLULAR SIGNALING PATHWAYS

- Transcription → key → gene expression is regulated to produce different cell types /allow cells to respond to specific stimuli.
- TFs need to be differentially active (in different cell types) and have activity modulated by specific stimuli.
- This allows them → turn to switch their target genes on or off in appropriate cell types or in response to specific signal → producing appropriate alterations in cellular phenotype.

## REGULATION OF TRANSCRIPTION FACTORS

- TFs need to be differentially active, and have activity modulated by specific stimuli
- Method 1 (SLOW) (B): Regulation of TF synthesis
  - Gene control is mediated by the transcription factor being synthesised = dependent on the tissues and cell types
  - Frequently used for expression over a long time
  - Achieves this by synthesising and maintaining the expression of a TF for a certain period of time.
  - E.g. cell-type specific or developmental regulated genes
- Second TF required to regulate transcription of 1<sup>st</sup> TF
  - Regulated at the level of its own transcription
  - = Potentially endless hierarchy of TF genes each requiring another TF to regulate its transcription
  - Solution: post-transcriptional regulation, or
- Method 2 (FAST) (A): Regulation of TF activity
  - Alteration of pre-existing protein ( when in an inactive form/target genes are not being expressed )
  - Activates post-transcriptionally → TF is controlled and regulated by controlling the activity of its pre existing

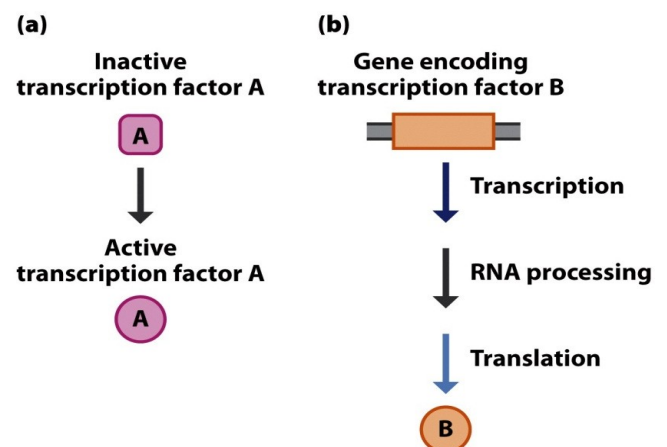


Figure 8.3 Gene Control (© Garland Science)

transcription factor protein.

- More rapid response

**EXAMPLE OF MECHANISM** → HSF → binds -Heat shock element (HSE) → in DNA of stress inducible genes → plays role in induction in response to elevated temperature or other stresses.

- HSF → present in cells before exposure to heat shock and can activate heat-shock genes following exposure to elevated temp, stresses, or presence of protein inhibitors preventing its de novo synthesis.
  - Heat shock activates inactive form of HSF → post-transcriptional modification involving an alteration of pre-existing protein.
- This method is frequently used in the response of cells to signalling pathways (rapid change in cellular gene expression in response to signal is required)
  - Exposure to a cell specific signal → change in TF activity → produce changes → expression of target genes for TF.
  - Altered levels of proteins encoded by these target genes will then produce the appropriate change → cellular characteristics in response to signal change → allows signal to have biological effect

### **MULTIPLE MECHANISMS REGULATE TF ACTIVITY**

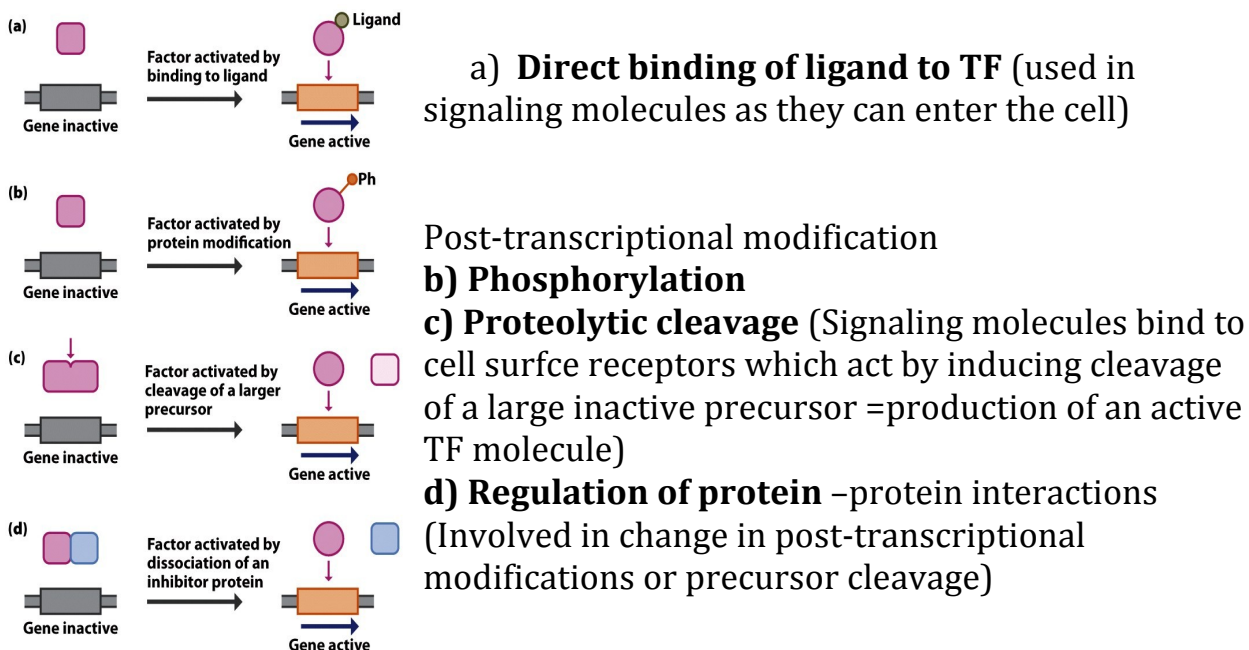


Figure 8.5 Gene Control (© Garland Science)

Signaling pathways can regulate:

1. Histone modifications (role in the regulation of chromatin structure)
2. Post-transcriptional processes (role in gene control)