CONCEPT: ACTION OF TRANSCRIPTION REGULATORS

Combinatorial Control

● Combination of regulator proteins _____ gene expression

□ Multiple proteins work together to determine the expression of a single gene

- Usually the first protein has high affinity, and then binding increases the affinity of other proteins

- Limits the number of transcription regulators needed

□ Expression can be decided by a single regulator protein

- Works like an on/off switch by completing the combination

□ Combinations can control the generation of different cell types

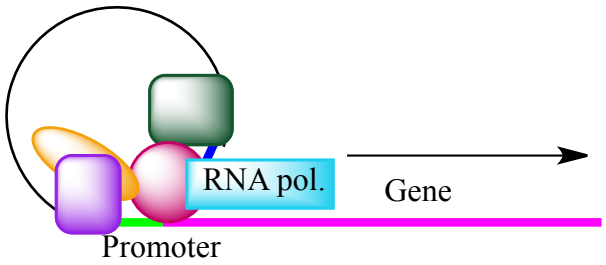
- A few transcription regulators control sets of genes resulting in cell differentiation

□ Combinations can be controlled by environmental signals

- **Response elements** are DNA sequence in a promoter that can bind to regulator proteins

- Ex: Heat-shock response elements, hormones

EXAMPLE: Combinations of regulatory proteins control gene expression



Steps to Gene Activation

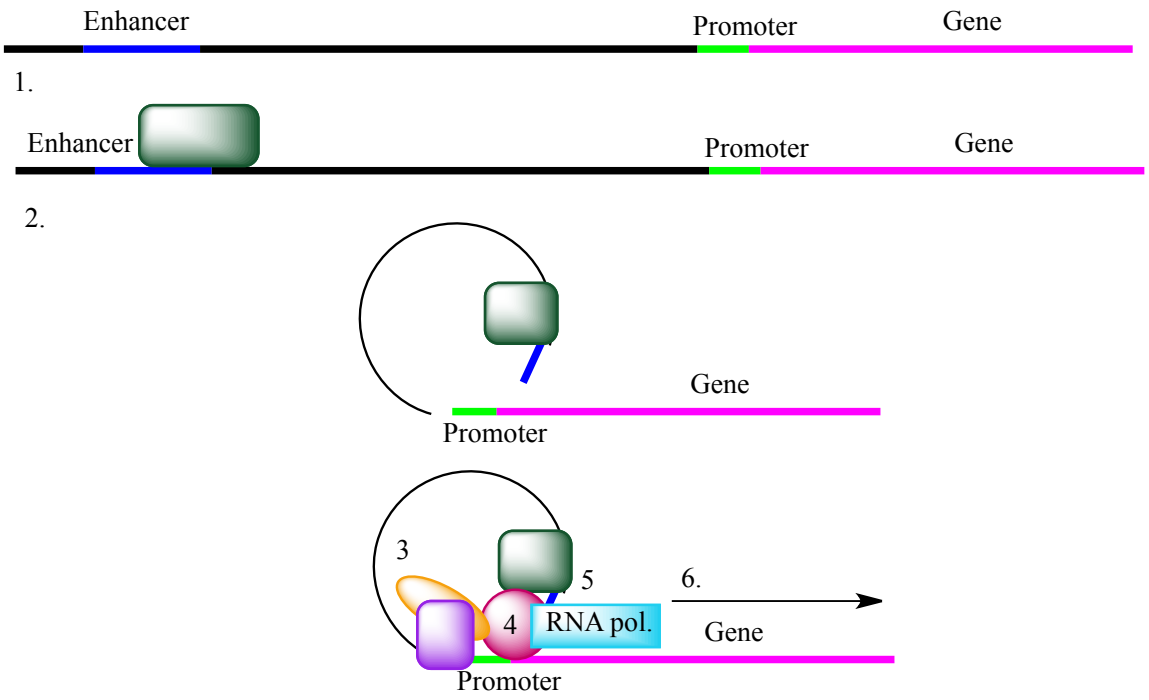
● Gene activation occurs in 6 steps

1. Regulatory proteins bind to an enhancer
2. This binding stimulate the DNA to form a loop which connects the enhancer and promoter
3. Activators interact with coactivators to alter chromatin structure
4. Activators interact with the mediator

5. Mediator facilitates the correct positions of RNA polymerase

6. RNA polymerase begins transcribing

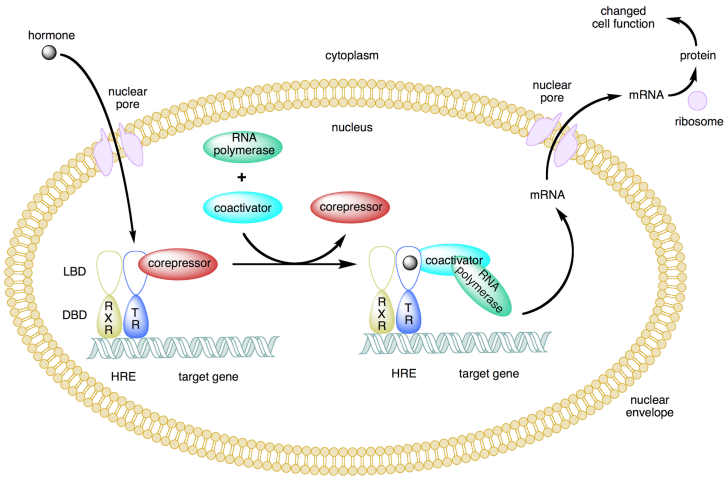
EXAMPLE: Steps to gene activation



Nuclear Receptors and Hormones

- **Nuclear receptors** are transcriptional regulators that sense hormone (steroids) and regulate gene expression
  - □ Nuclear receptors contain a few important _____
    - N-terminal act as an activation domain
    - Has a DNA binding domain
  - □ **Inverted repeats** are sequences of nucleotides followed by a reverse complement downstream
    - **Hormone response elements** are inverted repeats that many nuclear receptors bind

EXAMPLE: Hormone activation of a gene



PRACTICE

1. Choose all of the following factors involved in combinatorial control of gene expression.
    a. Regulatory proteins
    b. Response elements
    c. Histone Proteins
    d. RNA polymerase
    e. Glycosylation

2. What are nuclear receptors?
    a. Hormones
    b. Receptors found on the surface of the nucleus
    c. Receptors found on the surface of the cell
    d. Proteins in the nucleus that bind to hormones