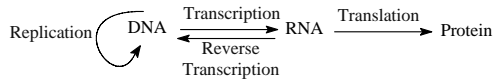


Gene Expression

Gene Expression- how much protein is in a cell (and active)



Genetic Regulation Constitutive vs. Inducible Expression

Constitutive- A gene is expressed at the same level at all times. AKA housekeeping gene.

Inducible- A gene is expressed at higher level under the influence of some signal.

Types of Regulation

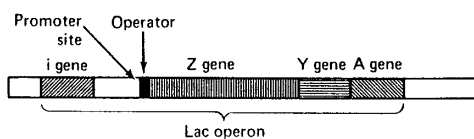
Fig. 41-2 Harper's ROB 24th Ed.

- Positive
- Negative
- Derepression

Points of Regulation

- Transcription
- Post-transcriptional modification
- mRNA degradation rate
- Translation
- Posttranslational modification
- Protein targeting and transport
- Protein degradation

Genetic Regulation - The Operon

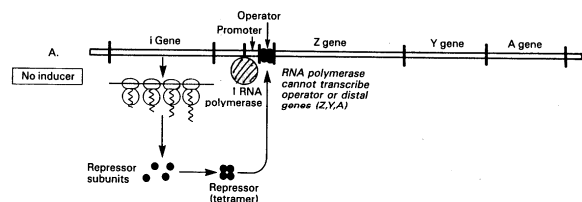


Operon- an operator plus two or more genes under control of that operator

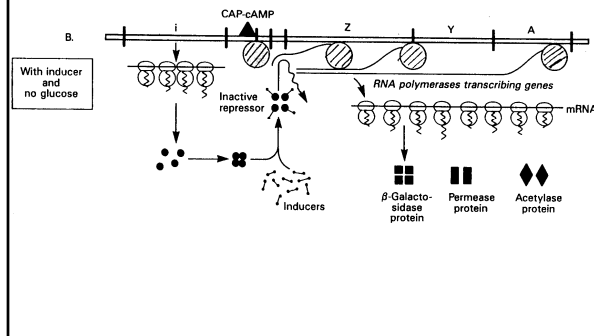
Occurs only in prokaryotes (in eukaryotes, each gene is under separate control).

Best known is the lac operon of Jacob and Monod

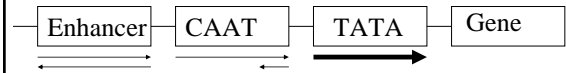
The Operon Under Normal Expression



The Operon Under Induced Expression



Eukaryotic Transcriptional Regulation



TATA box- where to start

CAAT box and Enhancer- how often to start

Helix-loop-helix motif proteins

Fig. Rasmol Screenshot 3CRO

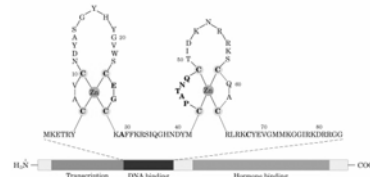
- β 3 surfaces interact with each other
- α 3 involved in DNA recognition
- Diameter of α -helix 1.2 nm (size of the major groove)
- Dimer-binding sites span 3.4 nm (fit in successive $\frac{1}{2}$ turns of major groove)



Zinc finger motif proteins

Fig. 28-31 Lehninger POB 4th Ed.

- Closely spaced cys-cys followed ~12-13 residues by closely spaced cys-cys or cys-his or his-his pair
- ~5 bp contacted
- Successive fingers 1 turn apart in major groove



Leucine Zipper motif proteins

Rasmol 1HJB (but see Fig. 28-14 Lehninger POB 4th Ed.)

- 30 amino acid residue sequence in C-terminus (of C/EBP)
- Leu every 7th residue
- Repeat 4x
- Form homo- or heterodimers



Types of Proteins Involved in the Regulation of Gene Expression

- Helix-loop-helix motif
 - Cro, homeo boxes
- Zinc Fingers
 - Steroid receptor
- Leucine zippers
 - C/EBP
- If a protein of unknown origin is found to have any of these motifs, it is assumed it is a DNA binding protein

Common Features of Proteins in Gene Expression Regulation

- Binding is of high affinity to the specific site and low affinity elsewhere
- Small regions of the proteins make direct contact with DNA
- Protein-DNA interactions are maintained by hydrogen bonds and van der Waals interactions
- Form symmetric dimers (binding sites are symmetric *palindromes*)

Post-Transcriptional Regulation

1. mRNA stability can be altered by signal molecules

PEPCK

- +Insulin = 30 min
- -Insulin = 3 h

Other Methods of Eukaryotic Gene Regulation

- Gene amplification
- Gene rearrangement
- RNA processing
 - Alternate mRNA splicing
 - Transport of mRNA from nucleus to cytoplasm
 - Regulation of mRNA stability
- Active vs. inactive chromatin: ^mCpG islands

Types of Mutations at the DNA Level

- Frame shift-Insertion
- Frame shift- Deletion
- Transition-Pu to other Pu or Pyr to other Pyr
- Transversion-Pu to Py or *vice versa*

Types of Mutations at the Protein Level

- Silent: base change results in no change in amino acid (wobble)
- Missense: one amino acid converted into another. Doesn't always cause problems.
- Nonsense: a stop codon is introduced, short protein