12.S: Regulation of Gene Expression (Summary)

- Regulation of gene expression is essential to the normal development and efficient functioning of cells.

- Gene expression may be regulated by many mechanisms, including those affecting transcript abundance, protein abundance, and post-translational modifications.

- Regulation of transcript abundance may involve controlling the rate of initiation and elongation of transcription, as well as transcript splicing, stability, and turnover.

- The rate of initiation of transcription is related to the presence of RNA polymerase and associated proteins at the promoter.

- RNApol may be blocked from the promoter by repressors, or may be recruited or stabilized at the promoter by other proteins including transcription factors.

- The lac operon is a classic, fundamental paradigm demonstrating both positive and negative regulation through allosteric effects on trans-factors.

- In eukaryotes, cis-elements that are usually called enhancers bind to specific trans-factors to regulate transcriptional initiation.

- Enhancers may be modular, with each enhancer and its transcription factor regulating a distinct component of a gene’s expression pattern, as in the yellow gene.

- Sticklebacks provide examples of recent evolutionary events in which mutation of an enhancer produced a change in morphology and a selective advantage.

- Chromatin structure, including reversible modifications such as acetylation of histones, and methylation DNA CpG sites also regulates the initiation of transcription.

- Chromatin modifications or DNA methylation of some genes are heritable over many mitotic, and sometimes even meiotic divisions.

- Heritable changes in phenotype that do not result from a change in DNA sequence are called epigenetic. Many epigenetic phenomena involve regulation of gene expression by chromatin modification and/or DNA methylation.
Key Terms:

- gene expression
- transcriptional regulation
- operon
- lactose
- glucose
- lac operon
- lacZ
- lacY
- lacA
- galactosidase
- permease
- trans-acetylase
- P / promoter
- O / operator
- CBS
- CAP-binding site
- cis-elements
- trans-regulators
- lacI
- homotetramer
- repressor
- allosteric
- cAMP binding protein
- adenylate cyclase
- constitutive
- $O^C / I / I^s$
- F-factor / episome
- GC boxes
- CAAT boxes
- TATA boxes
- GAL4-UAS
- Driver/responder
- transcription start site
- enhancers/silencers
- transcription factors
- hemoglobin/heme/globin
- pseudogene
- gene families
- stickleback
- primordium
- chromatin remodeling
- acetylation/deacetylation
- methylation/demethylation
- CpG sites
- epigenetics

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