

Molecular Biology 101

Networks

The Dynamics of Cells

- all cells in an organism have the same genomic data, but the genes expressed in each vary according to cell type, time, and environmental factors
- there are networks of interactions among various biochemical entities in a cell (DNA, RNA, protein, small molecules) that carry out processes such as
 - metabolism
 - intra-cellular and inter-cellular signaling
 - regulation of gene expression

Overview of the E. coli Metabolic Pathway Map

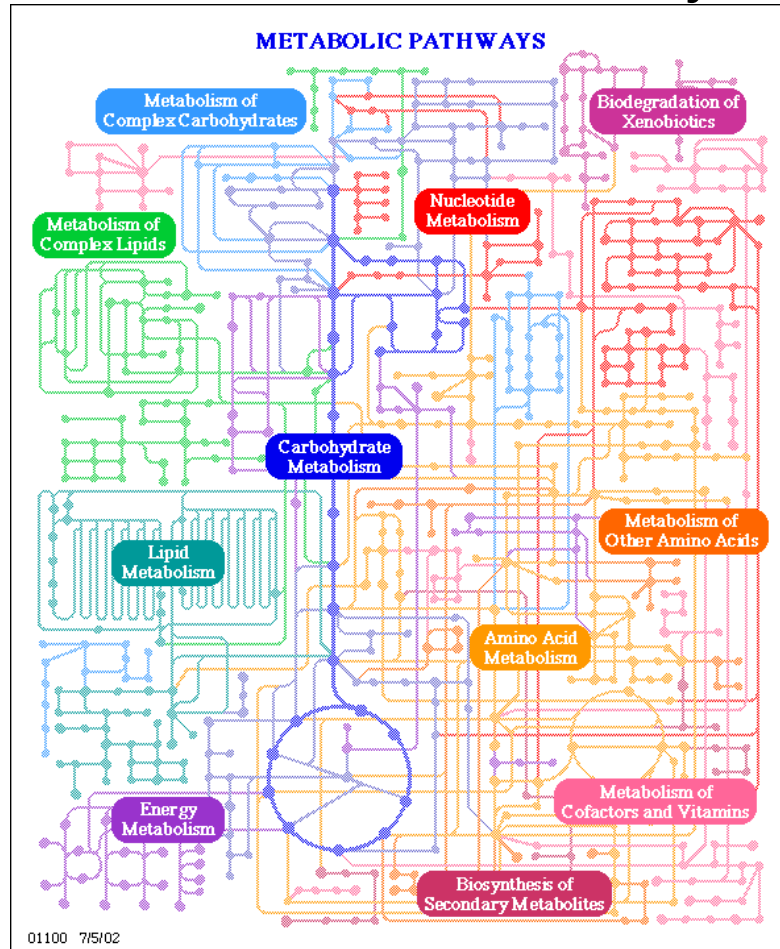


image from the KEGG database

The Metabolic Pathway for Synthesizing the Amino Acid Alanine

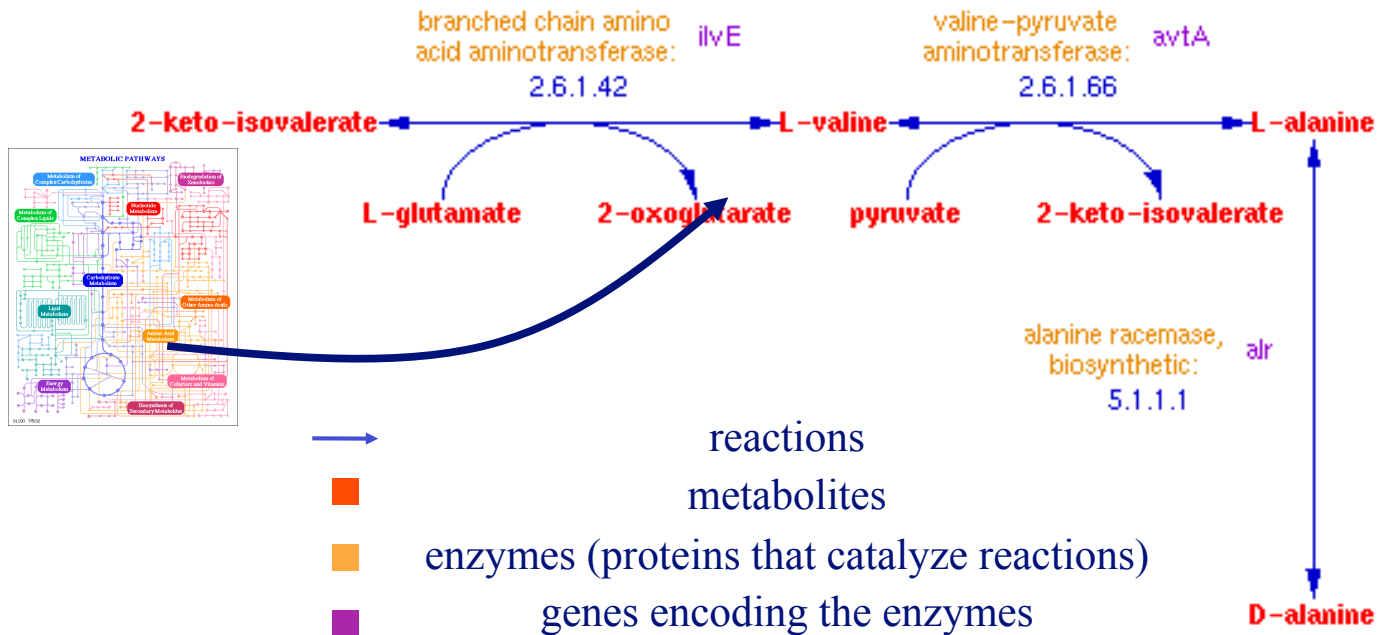
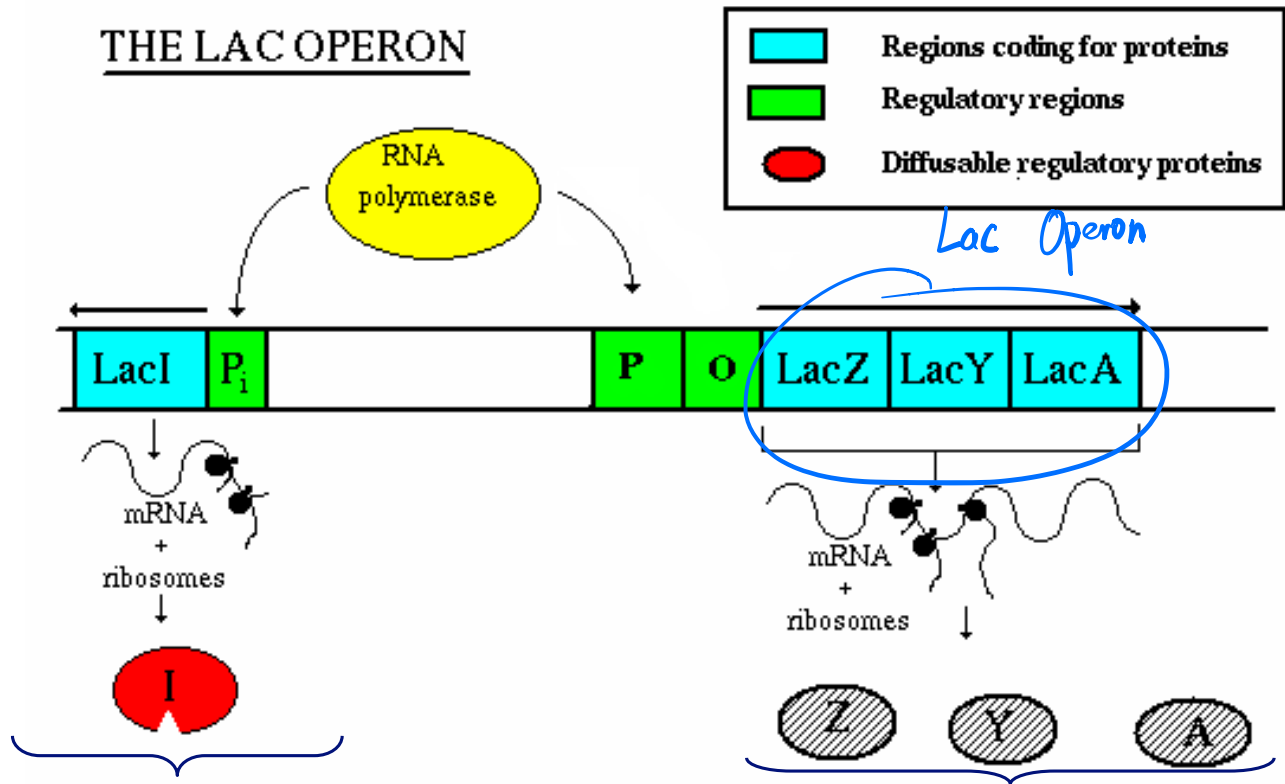


image from the Ecocyc database
www.biocyc.org

Gene Regulation Example: the lac Operon

THE LAC OPERON

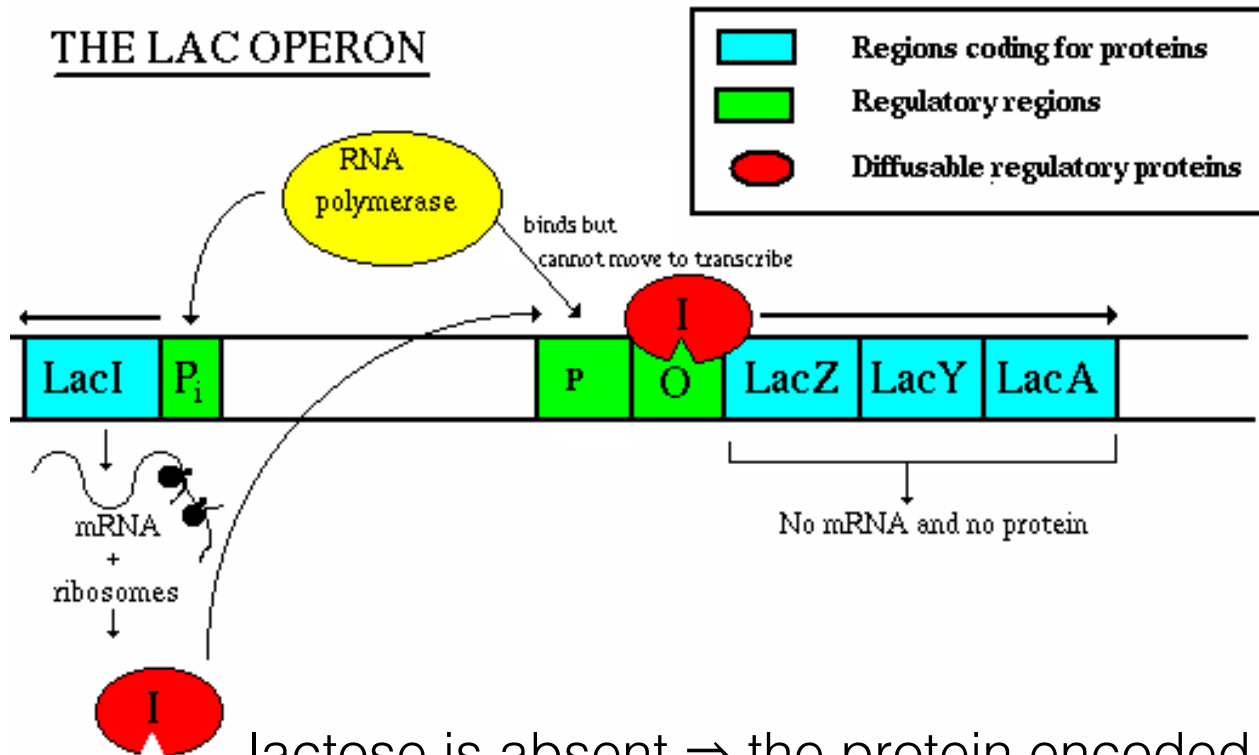


this protein regulates the transcription of LacZ, LacY, LacA

these proteins metabolize lactose

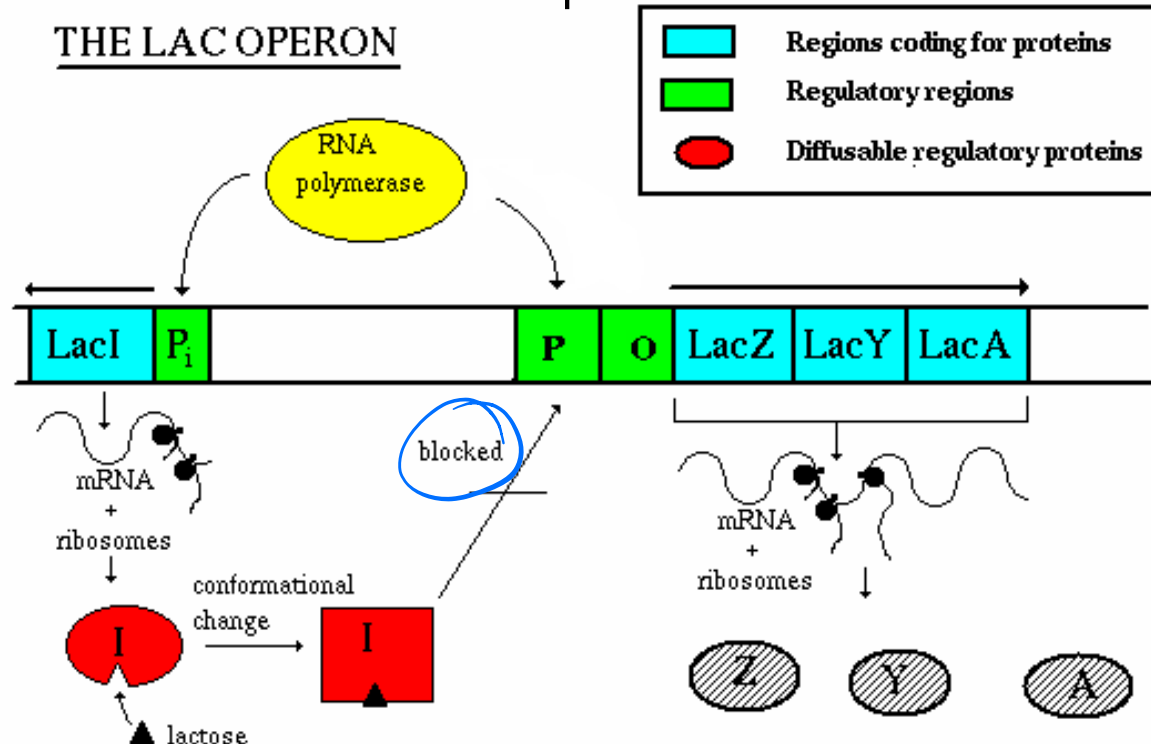
Gene Regulation Example: the lac Operon

THE LAC OPERON



lacI represses transcription of the lac operon

Gene Regulation Example: the lac Operon



lactose is present \Rightarrow it binds to the protein encoded by lacI changing its shape; in this state, the protein doesn't bind upstream from the lac operon; therefore the lac operon can be transcribed

Gene Regulation Example: the lac Operon

- this example provides a simple illustration of how a cell can regulate (turn on/off) certain genes in response to the state of its environment
- an operon is a sequence of genes transcribed as a unit
- the lac operon is involved in metabolizing lactose
 - it is “turned on” when lactose is present in the cell
 - the lac operon is regulated at the transcription level
- the depiction here is incomplete; for example, the level of glucose in the cell also influences transcription of the lac operon