

1  **Chapter 16**

Control of Gene Expression

2  **16.1 Regulation of Gene Expression**

- ▶ Gene regulation
 - ▶ Single celled organism
 - ▶ Only express a subset of genes at any given time
 - ▶ Change internal subset as external environment changes
 - ▶ Multicellular organism
 - ▶ Specialized cells all carry the same DNA
 - ▶ Only express a subset of genes for each cell type

3  **16.2 Aspects of Gene Regulation are Similar**

- ▶ Structural genes
 - ▶ Metabolism, biosynthesis & cell structure
- ▶ Regulatory genes
 - ▶ Products affect transcription or translation of other sequences
 - ▶ DNA binding
- ▶ Constitutive
 - ▶ Essential cellular functions
 - ▶ Expressed continually
- ▶ Regulatory elements
 - ▶ Not transcribed but affect expression of other sequences

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- ▶ Positive control
 - ▶ Stimulates gene expression
- ▶ Negative control
 - ▶ Inhibits gene expression

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- ▶ Levels of gene regulation
 - ▶ Alteration of gene structure
 - ▶ DNA packing
 - ▶ Methylation
 - ▶ Level of transcription
 - ▶ mRNA processing
 - ▶ RNA stability
 - ▶ Level of translation
 - ▶ Modify proteins

6  **16.3 Operons Control Transcription in Bacterial cells**

- ▶ Operon
 - ▶ Set of related genes under the control of a single promoter
 - ▶ Genes transcribed onto single mRNA

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- ▶ Regulator gene
 - ▶ Controls transcription of structural genes
 - ▶ Produces regulator protein
 - ▶ Binds to operator
 - ▶ Affects whether transcription takes place

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- ▶ Positive control
 - ▶ Stimulates gene expression
 - ▶ Regulatory protein is a activator
 - ▶ Binds to DNA and stimulates transcription
- ▶ Negative control
 - ▶ Inhibits gene expression
 - ▶ Regulatory protein is a repressor
 - ▶ Binds to DNA and inhibits transcription

- ▶ Inducible operon
 - ▶ Transcription normally off
- ▶ Repressible operon
 - ▶ Transcription normally on

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- ▶ **Negative inducible & repressible**
 - ▶ Regulatory protein is a repressor
 - ▶ Inhibits transcription
 - ▶ Allosteric protein
 - ▶ Inducer molecule
 - Changes repressor shape to prevent repressor binding
 - ▶ Corepressor molecule
 - Changes repressor shape to allow repressor binding

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- ▶ **Negative Inducible**
 - ▶ Excess substrate = inducer
 - ▶ Prevents repressor binding (turns on)

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- ▶ **Negative Repressible**
 - ▶ Excess product = corepressor
 - ▶ Allows repressor binding (turns off)

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- ▶ **Negative inducible & repressible**

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- ▶ **Positive inducible & repressible**
 - ▶ Regulatory protein is a activator
 - ▶ Stimulates transcription
 - ▶ Inducible = Substrate allows activator to attach (turns on)
 - ▶ Repressible = Product prevents activator from attaching (turns off)

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- ▶ **lac Operon**
 - ▶ *E. coli* (negative inducible)
 - ▶ Excess substrate (lactose) = inducer
 - ▶ Prevents repressor binding (turns on)

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- ▶ **Catabolite Repression**
 - ▶ Glucose always used first
 - ▶ Requires less energy to process
 - ▶ Positive control in response to glucose
 - ▶ Low glucose = lots of cAMP
 - ▶ Binds to catabolite activator protein (CAP) to increase transcription
 - ▶ High glucose = little cAMP

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▶ Will not bind to CAP and little transcription occurs