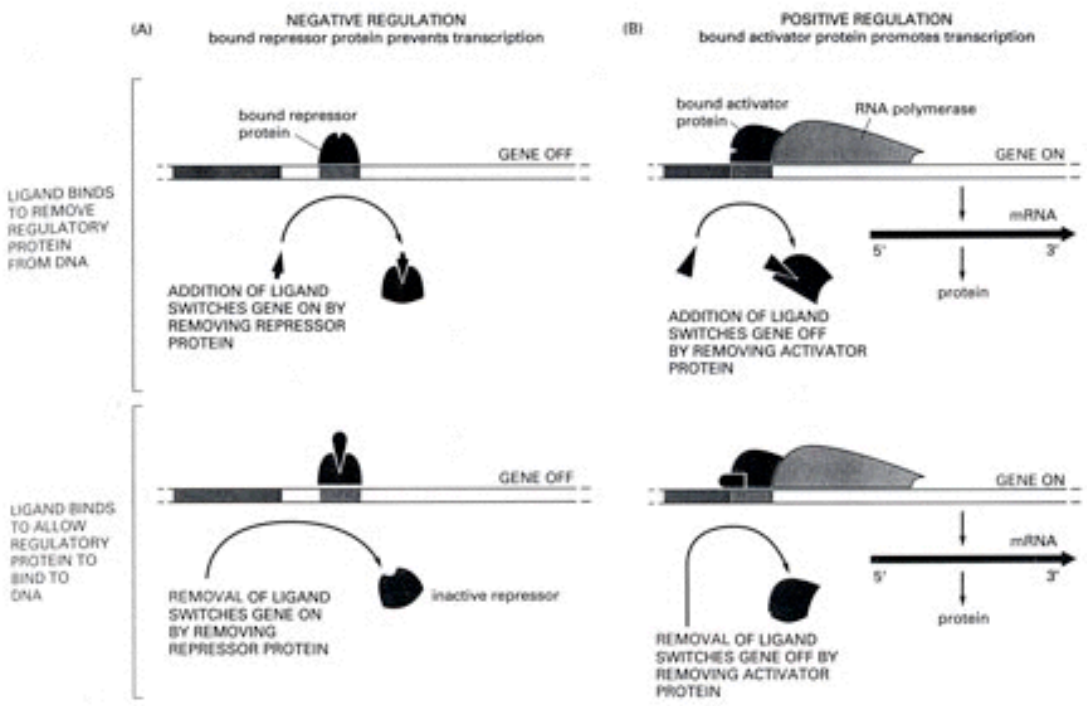
POSITIVE VS. NEGATIVE CONTROL of Transcription In Prokaryotes

Gene regulatory proteins are proteins that recognize and bind to specific short stretches of double-helical DNA and thereby determine which of the thousands of genes in a cell will be transcribed. The mode of control may be negative or positive. By definition, **negative control** occurs when a *repressor* protein is involved, that is when a regulator protein is active, DNA-binding repressor prevents RNA polymerase from binding and turning the genes *off*. Positive control is the exact opposite of negative control: instead of interfering with the initiation of transcription, it enhances transcription. **Positive control** occurs when an active, DNA-binding regulatory protein binds to DNA and assists the binding of RNA polymerase and therefore facilitates transcription. Such regulator proteins are called transcriptional *activators*.

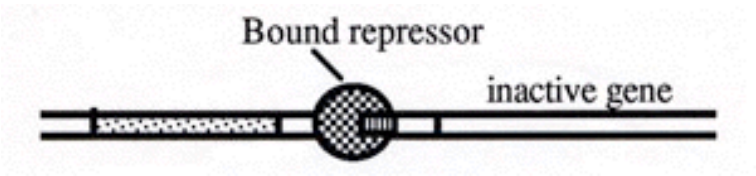


Note: A ligand is defined as any molecule that binds to a specific site on a protein molecule. The binding of a specific ligand to an allosteric protein causes the protein to reversibly change its shape, from an active to an inactive form, or vice-versa. In the case of the lac operon (upper left), the

ligand is the inducer (e.g. allolactose); in a repressible operon (bottom left), the ligand is a corepressor.

NEGATIVE VS. POSITIVE CONTROL MECHANISMS

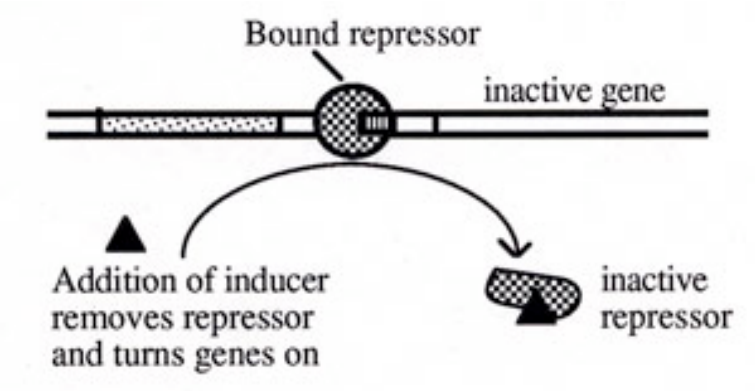
Negative control: Bound repressor protein prevents transcription.



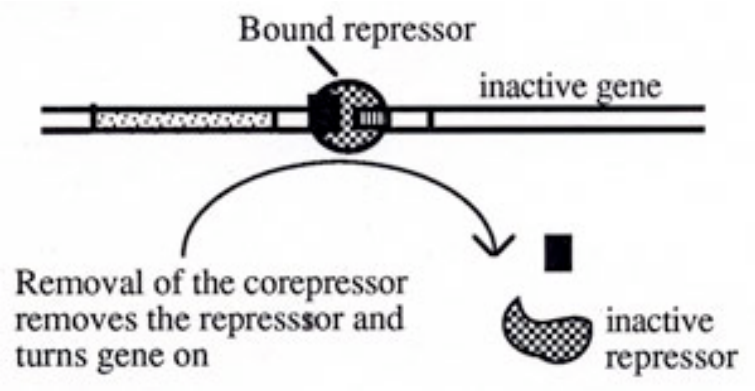
In negative control, the bacterial gene repressor protein binds to the operator near the promoter and thereby inhibits transcription of specific genes.

Examples:

An inducible operon:



A repressible operon:



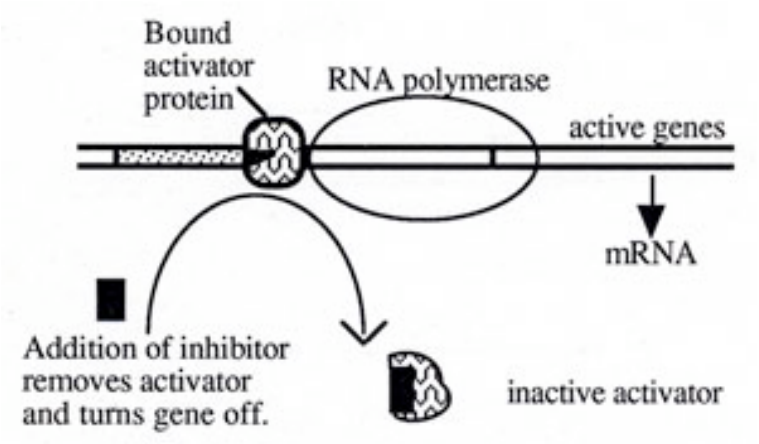
Because in both cases the binding of the regulatory protein suppresses transcription, this type of gene control is called *negative control*.

Positive control: Bound activator protein promotes transcription.

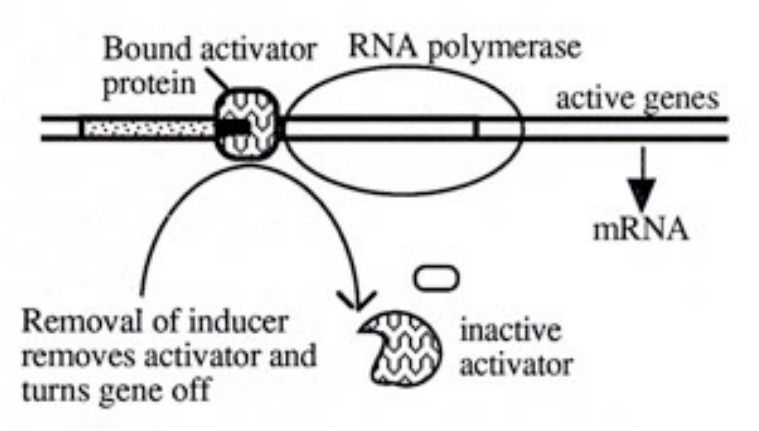
In positive gene control, a gene activator protein facilitates the action of RNA polymerase.

Examples:

Activator protein facilitates transcription unless removed by inhibitor:



Activator protein facilitates transcription unless inducer is removed and activator can no longer bind:



Because in both cases more transcription occurs in the presence of the activator protein than in its absence, this type of regulation is called *positive control*.

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