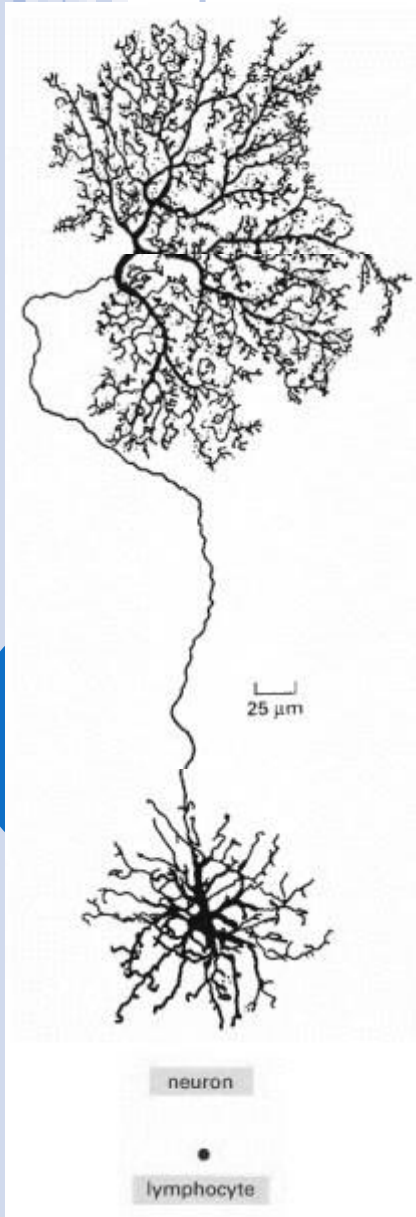


# GENE EXPRESSION

# WHAT IS GENE EXPRESSION?

- It is the process by which information from a gene is used in the synthesis of a functional gene product.
- These products are often proteins, but in non-protein coding genes such as rRNA genes or tRNA genes, the product is a functional RNA.
- 





## Gene expression regulation:

Both of these cells contain the same genome, but they express different RNAs and proteins.

# CLASSIFICATION OF GENE WITH RESPECT TO THEIR *EXPRESSION*:

- **Constitutive ( house keeping) genes:**
  - 1- Are expressed at a fixed rate, irrespective to the cell condition.
  - 2- Their structure is simpler
- ***Controllable genes:***
  - 1- Are expressed only as needed. Their amount may increase or decrease with respect to their basal level in different condition.
  - 2- Their structure is relatively complicated with some response elements



- Several steps in the gene expression process may be modulated, including the
- 1.transcription,
- 2. RNA splicing
- 3.translation, and
- 4.post-translational modification of a protein.



- Process of alteration of gene expression has been studied in detail & involves modulation of gene transcription.

transcription control can result in tissue specific gene expression & influenced by hormones, heavy metals.

In simple terms, regulation of gene expression is of two types

1. positive regulation.
2. negative regulation.



# 1. POSITIVE REGULATION:

When the expression of genetic is quantitatively increased by the presence of specific regulatory element is known as positive regulation.

Element modulating positive regulation is known as activator or positive regulator.



## 2. NEGATIVE REGULATION.

- when the expression of genetic information diminished by the presence of specific regulatory element.
- The element or molecule mediating the negative regulation is said to be repressor.



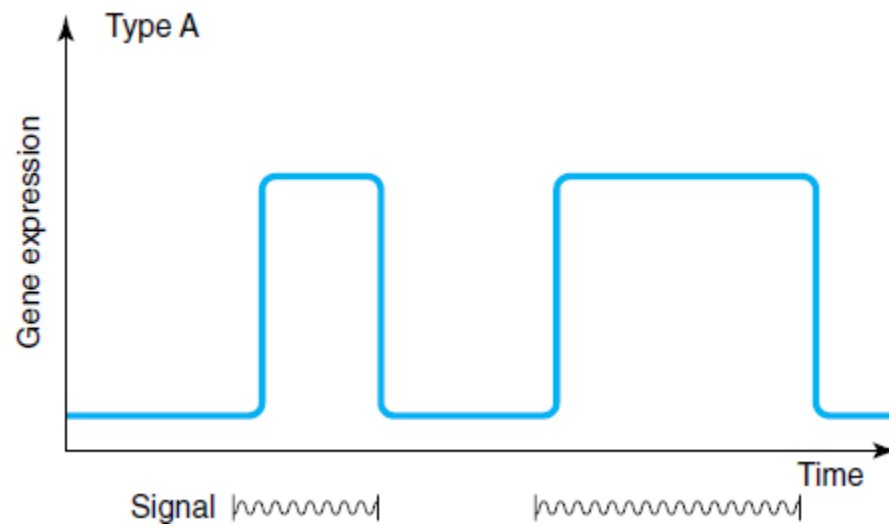


# TYPES OF *TEMPORAL* *RESPONSES:*

- Type A response: increased extent of gene expression is continued in presence of inducing signal.
- This is commonly observed in prokaryotes in response to intracellular conc. Of nutrient.
- TYPE B response: increased amount of g.ex. Is transient even in presence of regulatory signal.
- This is seen in commonly during development of organism.



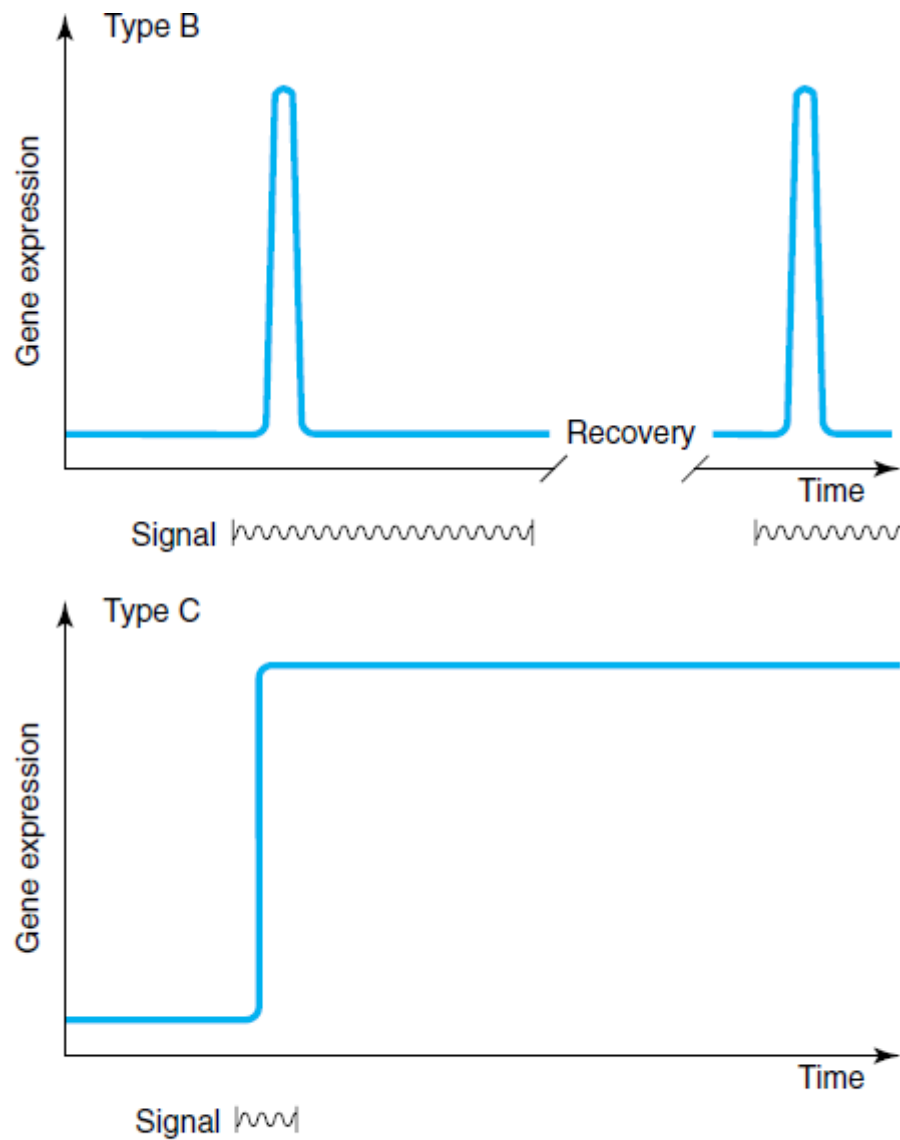
	Rate of Gene Expression	
	Negative Regulation	Positive Regulation
Regulator present	Decreased	Increased
Regulator absent	Increased	Decreased



TYPE C RESPONSE: INCREASED GENE EXPRESSION  
THAT PERSISTS EVEN AFTER TERMINATION OF  
SIGNAL.

IT IS SEEN IN DEVELOPMENT OF TISSUE OR ORGAN.






**Figure 39–1.** Diagrammatic representations of the responses of the extent of expression of a gene to specific regulatory signals such as a hormone.

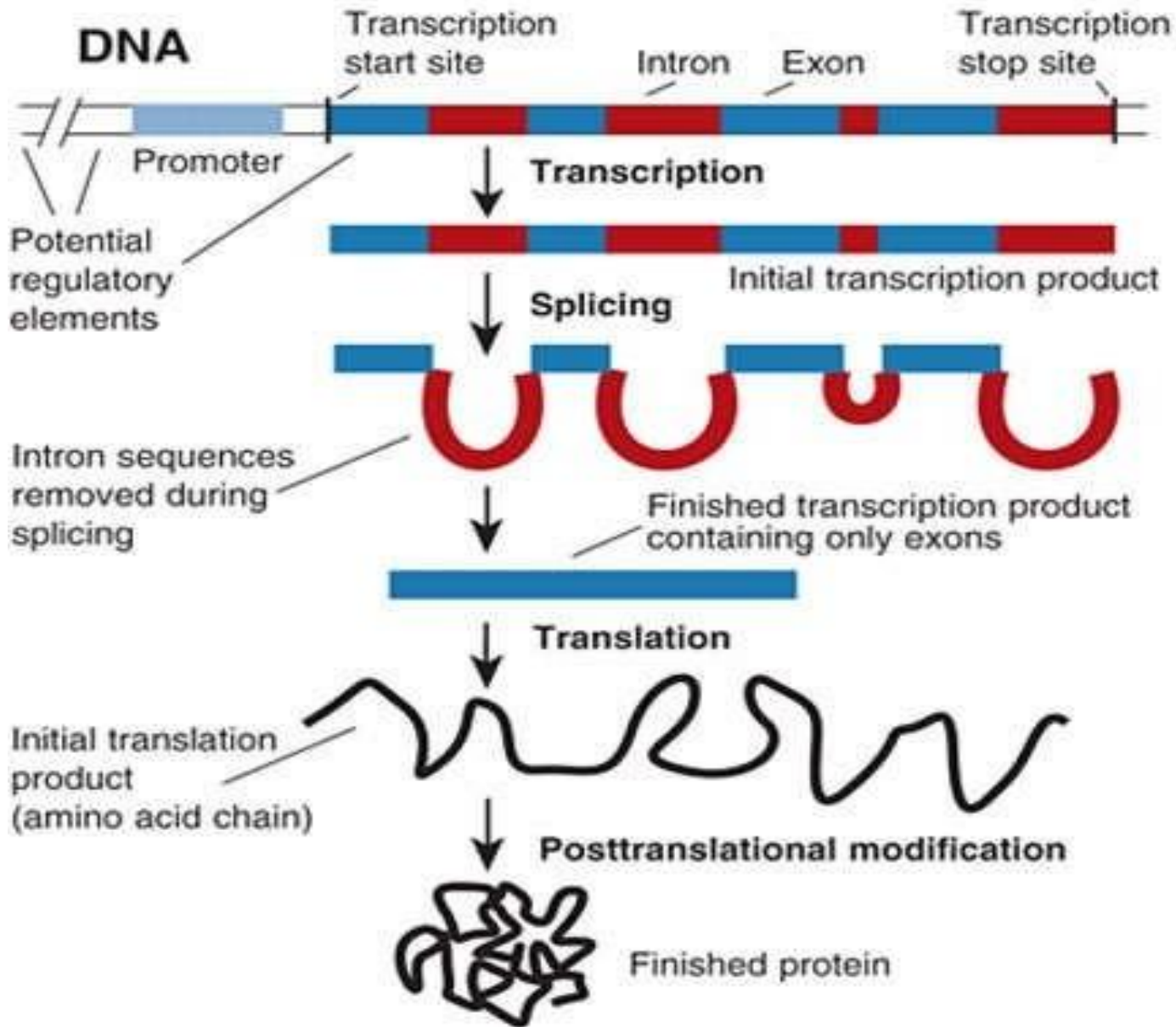


## TO KNOW AND EXPLAIN:

- ⊗ Regulation of Bacterial Gene Expression
  - ⊗ Constitutive ( house keeping) vs. Controllable genes
  - ⊗ OPERON structure and its role in gene regulation
  - ⊗ Regulation of Eukaryotic Gene Expression at different levels: DNA methylation
    - Increasing the number of gene copies (gene amplification) Changing the rate of initiation of transcription
    - Alternate splicing mRNA stability
    - Changing the rate of initiation of
- 

- **Regulation of gene expression (or gene regulation):**
- includes the processes that cells and viruses use to turn the information in genes into gene products.
- Although a functional gene product may be an RNA or a protein, the majority of known mechanisms regulate protein coding genes
- Any step of the gene's expression may be modulated, from DNA-RNA transcription to the post-translational modification of a protein.





Gene regulation is essential for viruses, prokaryotes and eukaryotes as it increases the versatility and adaptability of an organism by allowing the cell to express protein when needed.

The first discovered example of a gene regulation system was the lac operon, discovered by Jacques Monod, in which protein involved in lactose metabolism are expressed by *E.coli* only in the presence of lactose and absence of glucose.





- Furthermore, gene regulation drives the processes of cellular differentiation and morphogenesis, leading to the creation of different cell types in multicellular organisms where the different types of cells may possess different gene expression profile.



## *Regulation of Gene Expression:*

- Principles of gene regulation
- Regulation of gene expression in prokaryotes
- Regulation of gene expression in eukaryotes



*Principles of Gene Regulation:*

Most prokaryotic genes are regulated in units called operons.

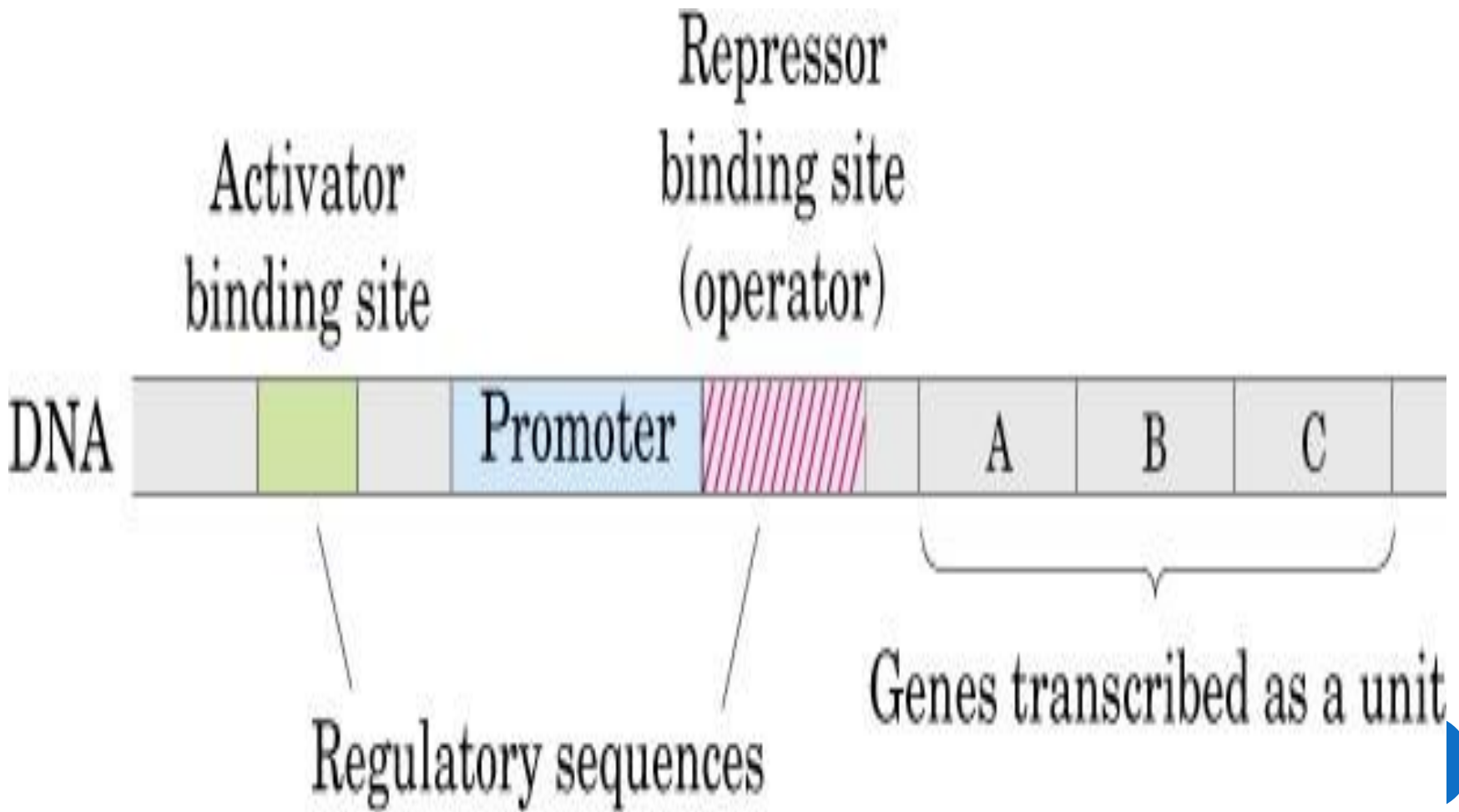
Francois Jacob & Jacques Monod, 1961.

This is largely based on regulation of lactose metabolism. By intestinal

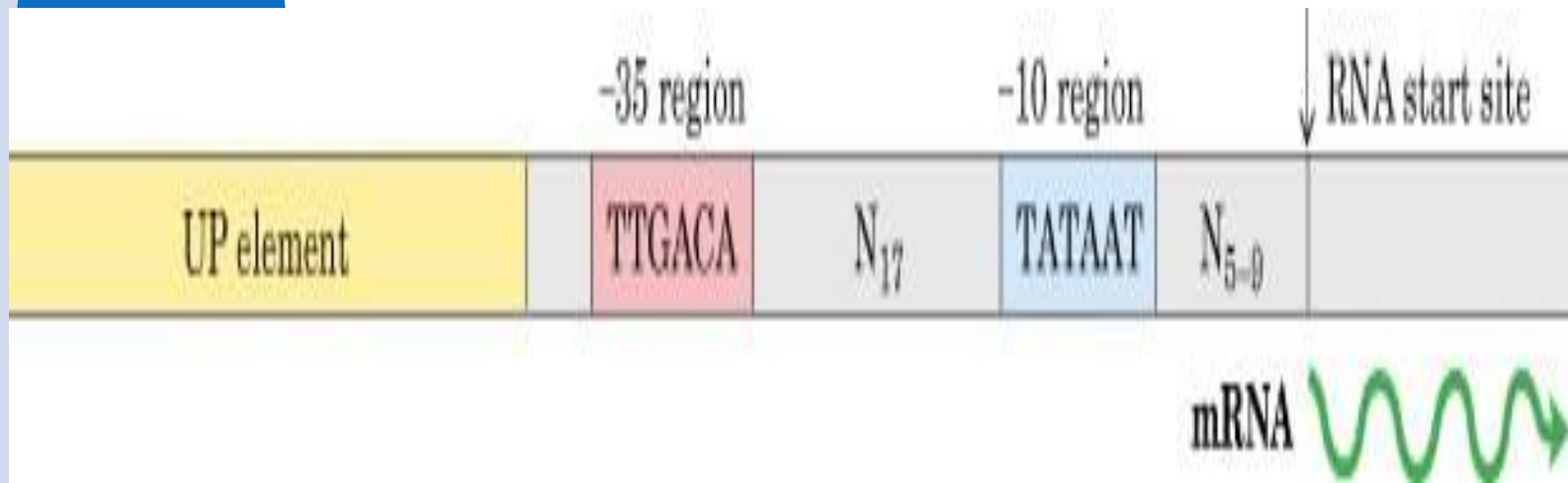


# O P E R O

N:



# 1) RNA polymerase binds to DNA at promoters



2) Transcription initiation is regulated by proteins that bind to or near promoters.

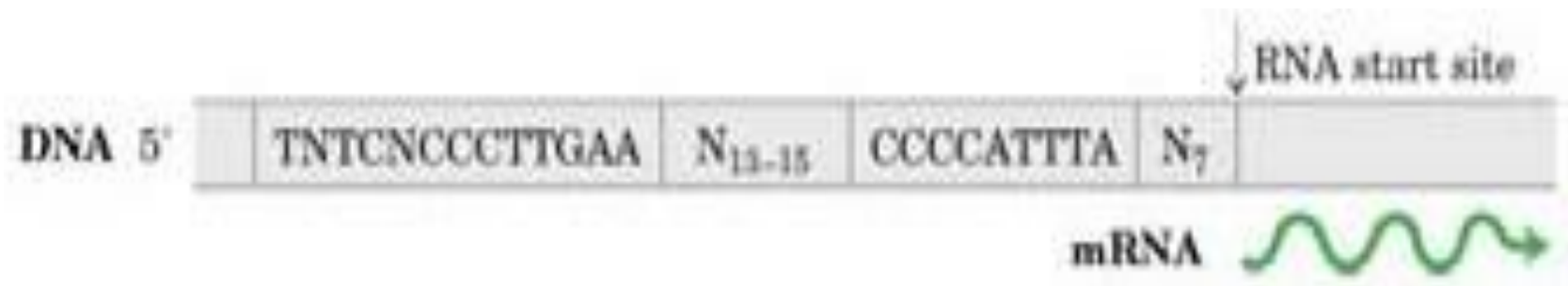
Repression of a repressible gene: (*i.e., negative regulation*) repressors (vs. activators) bind to operators of DNA.

Repressor is regulated by an effector, usually a small molecule

or a protein, that binds and causes a conformational change.

Activator binds to DNA sites called enhancer to enhance the RNA polymerase activity. (*i.e., positive regulation*)

Induction of an inducible gene, *e.g., heat-shock genes*.



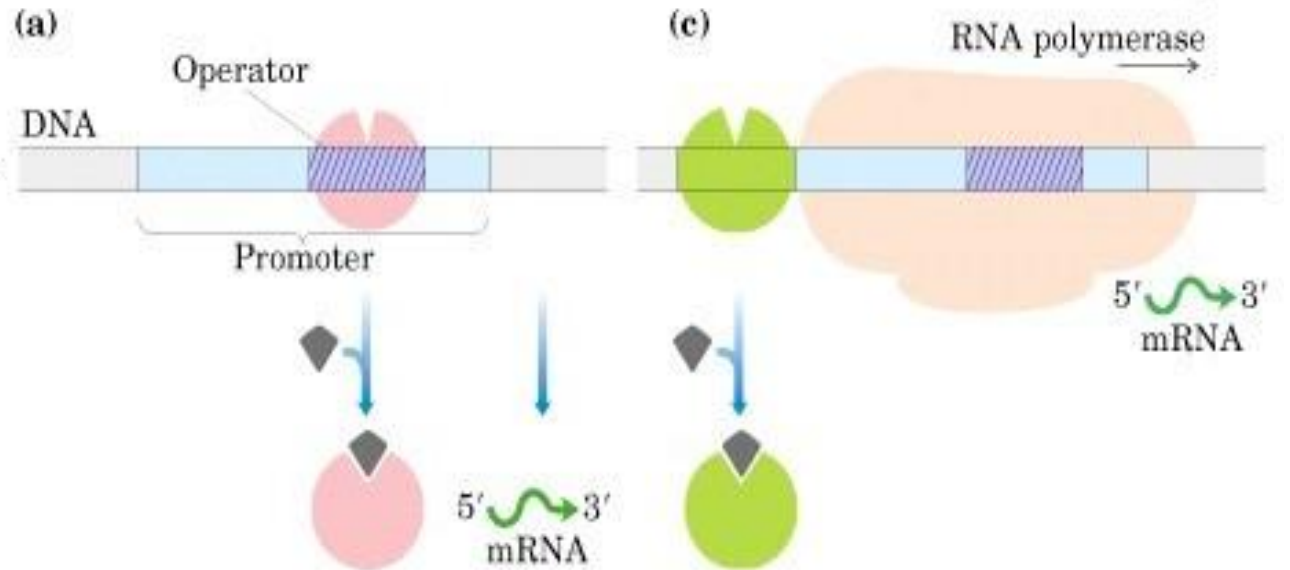
### Negative regulation

(bound repressor inhibits transcription)

### Positive regulation

(bound activator facilitates transcription)

Molecular signal (◆) causes *dissociation* of regulatory protein from DNA



Molecular signal (◆) causes *binding* of regulatory protein to DNA

