CONCEPT: LAC OPERON

● An **operon** is a group of genes with similar functions that are transcribed together

□ There are many _____ of an operon (PROG)

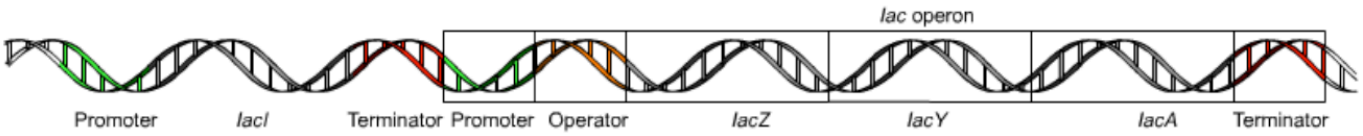
- **Promoter:** Region where transcription initiator binds to initiate transcription

- **Repressor:** A protein that can repress transcription of the operon

- **Operator:** Region where the repressor binds. The "on/off" switch

- **Genes:** The genes that are transcribed together

EXAMPLE:



● An ***lac* operon** was the first operon discovered. It was discovered by Jacob, and Monod in the 1960s

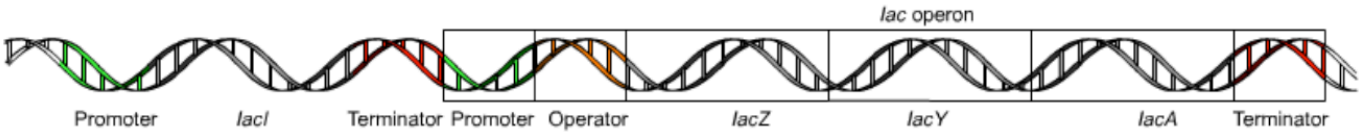
□ The *lac* operon encodes _____ that breakdown and process lactose

- *LacZ:* Encodes **beta-galactosidase** which converts lactose into glucose and galactose

- *LacY:* Ecodes **permease**, which allows lactose to enter into the cell

- *LacA*: Encodes **transacetylase**, which has an unknown function but is crucial for lactose processing

EXAMPLE:



Lac operon regulation

- The lac operon responds differently to different lactose _____

    □ When the lactose concentration is **high**:

        - Lactose binds to the repressor, causing it to be removed from the operator

        - When the repressor is removed, transcription of the operon can take place

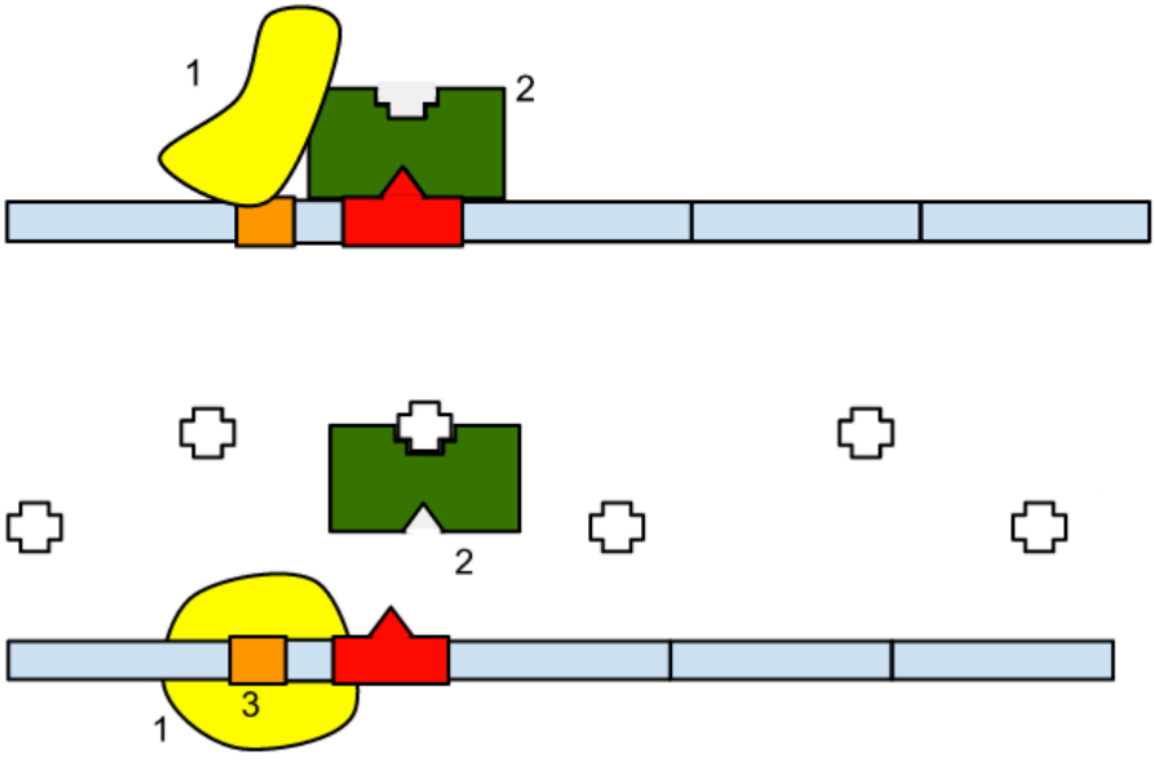
        - The *lac* operon genes are made, and then can act to breakdown lactose

    □ When the lactose concentration is **low**:

        - Lactose doesn't bind to the repressor, causing it to remain on the operator

        - Transcription does not take place

EXAMPLE:



- The lac operon can also respond to glucose _____

  - The **catabolite activator protein (CAP)** represses the *lac* operon when glucose is present

    - When glucose is present it inhibits activity of **adenyl cyclase,** which works to create **cAMP**

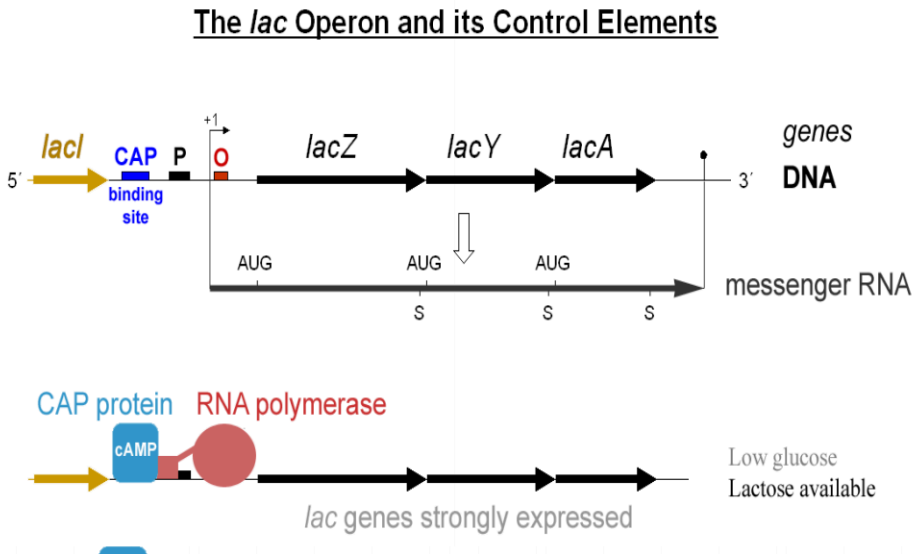
    - When the **cAMP** concentration is high it binds CAP, and when it is low it doesn't bind to CAP

    - CAP/cAMP complex binds **CAP site** upstream of the *lac* promoter and activates transcription

      - When glucose is **high**, it will inhibit cAMP production, and will not activate transcription

      - When glucose is **low**, there will be high cAMP production, which will activate transcription

EXAMPLE:

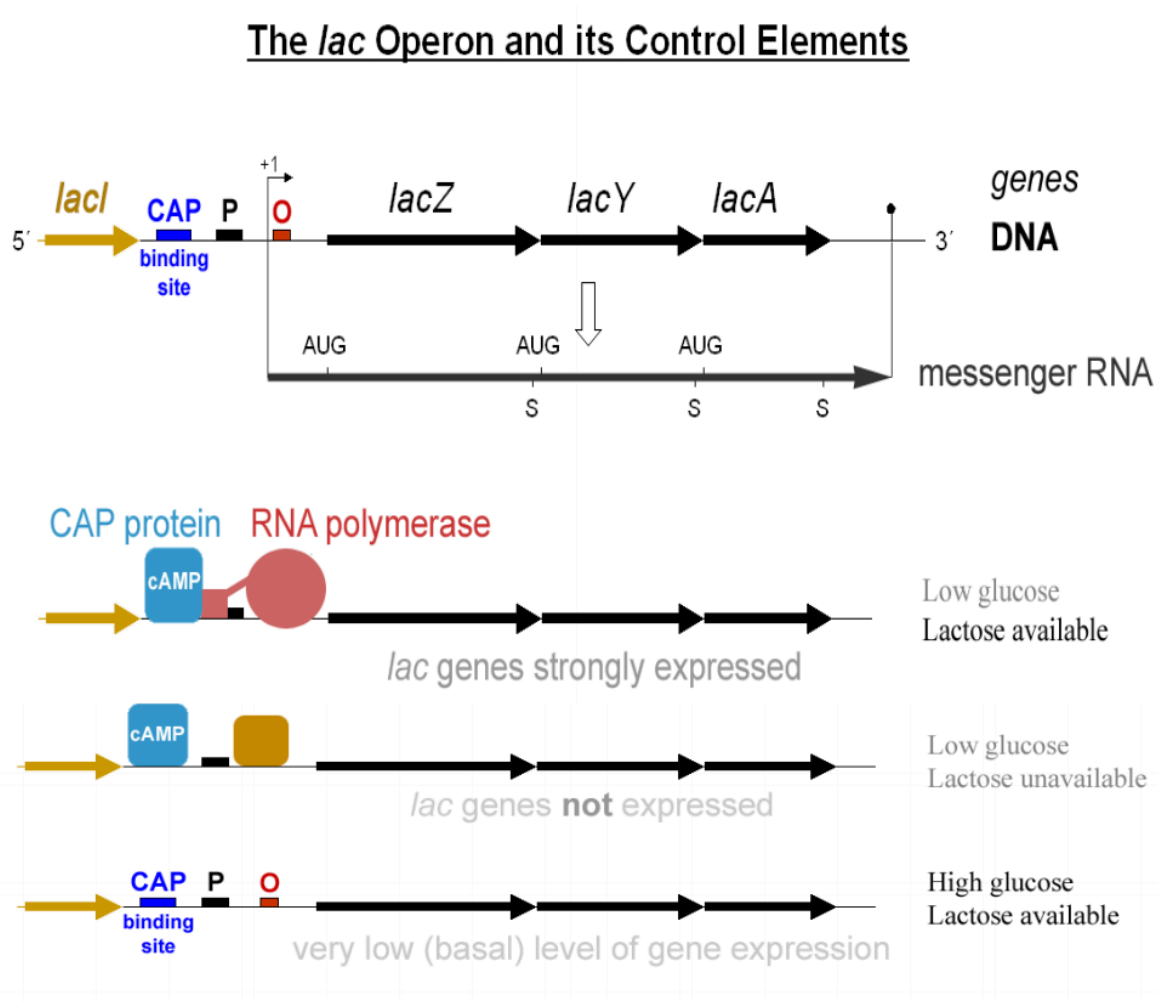


Summary of *lac* operon expression

- Therefore the *lac* operon has different functions depending on the _____ of glucose and lactose
  - □ If glucose and lactose are both present, the cell would prefer to utilize glucose, because it is simpler
    - But, if you only have lactose, then the cell has to break down lactose to generate glucose

Lactose	Glucose	*Lac* Expression
High	Low	Strongly Expressed
Low	High	Not Expressed
Low	Low	Not Expressed
High	High	Somewhat Expressed

EXAMPLE:



PRACTICE:

1. Which of the following is not a part of an operon?
    a. Promoter
    b. Repressor
    c. Operator
    d. Enhancer

2. The *lac* operon encodes genes that are responsible for what?
    a. Synthesizing more lactose
    b. Breaking down lactose
    c. Carrying lactose to the mitochondria
    d. Converting lactose into cellulose

3. What happens to the *lac* operon when lactose concentration is high?
    a. The *lac* operon is activated, and lactose is synthesized
    b. The *lac* operon is activated, and lactose is broken down
    c. The *lac* operon is repressed, and lactose is synthesized
    d. The *lac* operon is repressed, and lactose is broken down

4. What happens to the *lac* operon when the CAP/cAMP complex binds to the CAP binding site?
    a. The *lac* operon genes are transcribed
    b. The *lac* operon genes are suppressed
    c. Lactose is synthesized

5. True or False: Glucose concentration can regulate the *lac* operon?
    a. True
    b. False