AP BIO INSTA-REVIEW

TOPIC 6.5

Regulation of Gene Expression

IST-2.A.1

Regulatory sequences are stretches of DNA that interact with regulatory proteins to control transcription.

IST-2.A.2

Epigenetic changes can affect gene expression through reversible modifications of DNA or histones.

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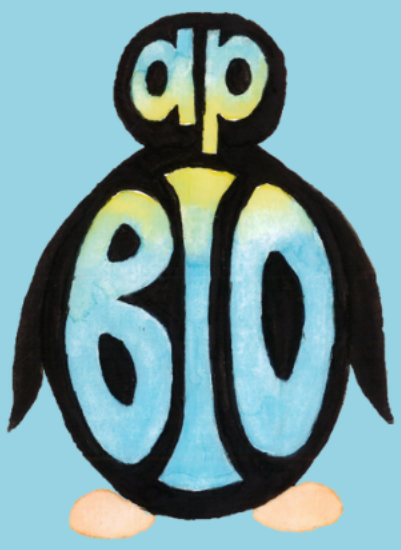

Regulation of Gene Expression

IST-2.A.3

The phenotype of a cell or organism is determined by the combination of genes that are expressed and the levels at which they are expressed–

a. Observable cell differentiation results from the expression of genes for tissue specific proteins.

b. Induction of transcription factors during development results in sequential gene expression.

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TOPIC 6.5

Regulation of Gene Expression

IST-2.B.1

Both prokaryotes and eukaryotes have groups of genes that are coordinately regulated–

a. In prokaryotes, groups of genes called operons are transcribed in a single mRNA molecule. The lac operon is an example of an inducible system.

b. In eukaryotes, groups of genes may be influenced by the same transcription factors to coordinately regulate expression.

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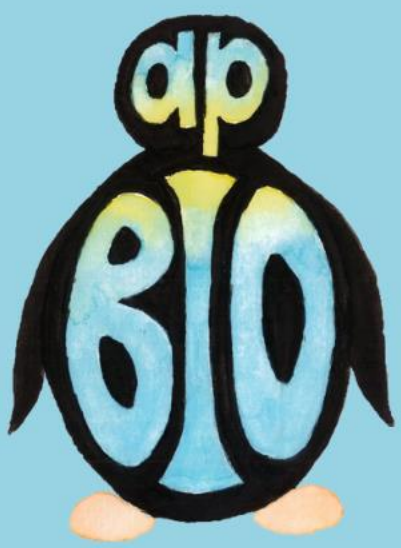

Describe the effect of DNA methylation

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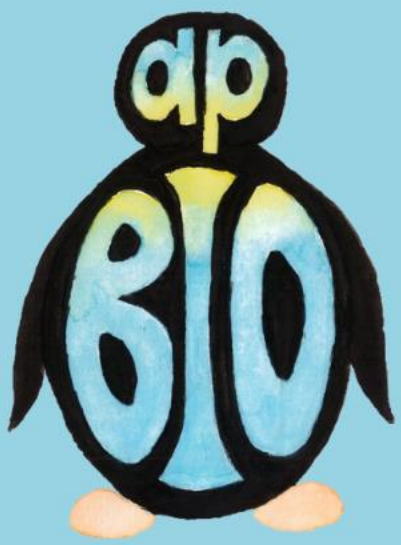

Describe the effect of DNA methylation

DNA methylation involves binding methyl groups to the DNA. This causes the strand to condense which will inhibit transcription (so decreases gene expression)

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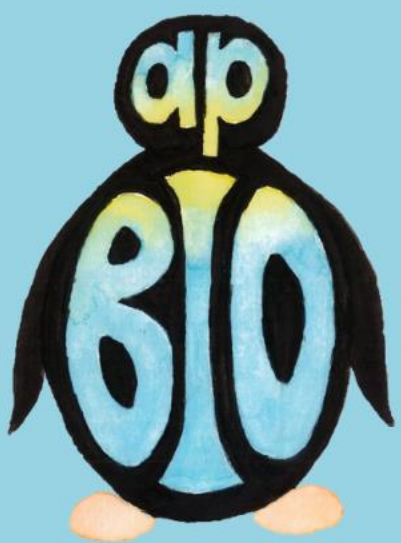

Describe the effect of histone acetylation

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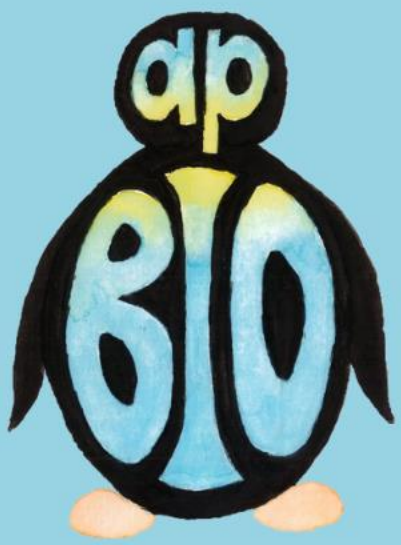

Describe the effect of histone acetylation

Firstly, histones are the proteins that DNA wraps around to condense.

The acetylation decreases the binding between DNA and histone which causes the DNA to loosen. This increases transcription or stimulates gene expression.

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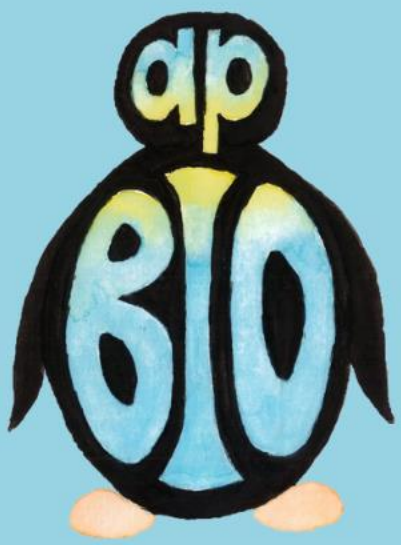

What are the transcription factors?

A. Molecules that provide ATP to transcription unit

B. Molecules that synthesize RNA during transcription

C. Molecules that bring amino acids to the transcription unit

D. Molecules that bind to enhance/inhibit transcription.

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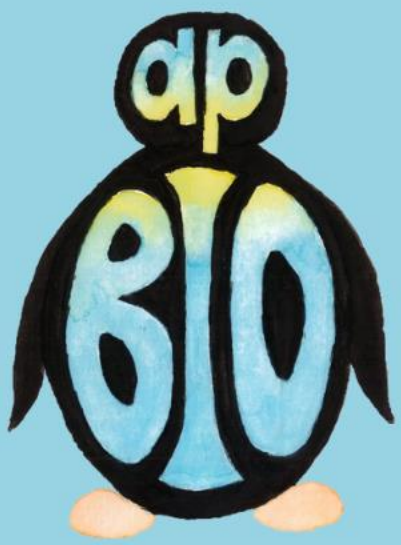

What are the transcription factors?

D. Molecules that bind to enhance/inhibit transcription.

Transcription factors bind to the enhancer regions to assist RNA polymerase to bind to the promoter to initiate transcription

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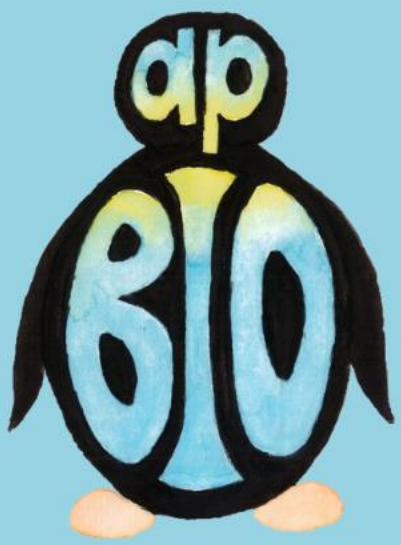

All somatic (body) cells have the same genetic information

A. True

B. False

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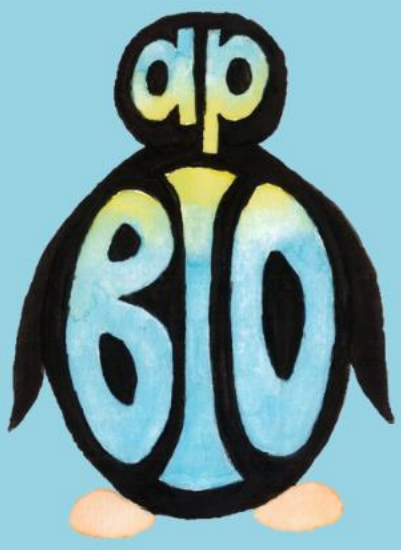
All somatic (body) cells have the same genetic information

A. True



All of your cells resulted from a single cell (zygote) that underwent mitosis so you could grow. All of your cells have the SAME DNA (except for your gametes due to meiosis)

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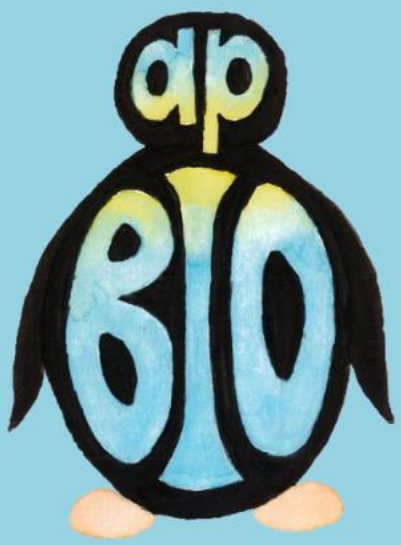

If all the cells have the same DNA how are your cells so different?

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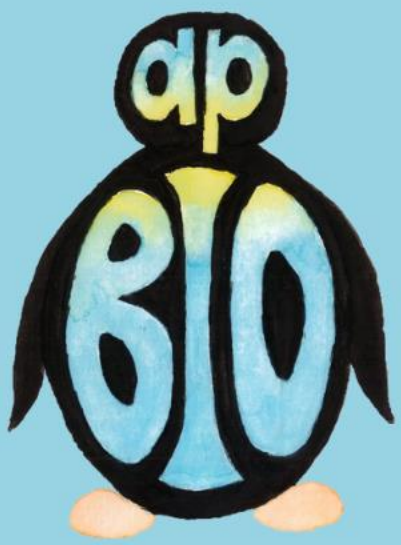

If all the cells have the same DNA how are your cells so different?

Cell differentiation

The cells have different transcription factors/activators which will enhance transcription of certain genes.

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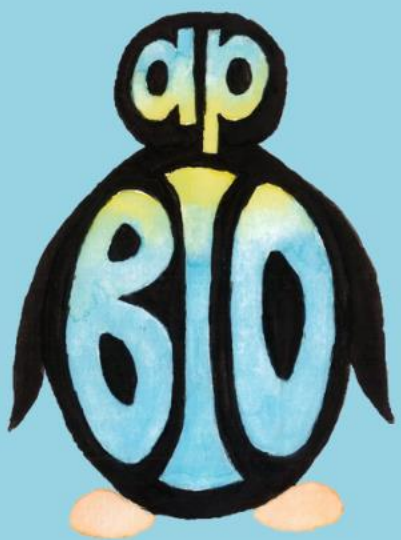

What types of cells have operons?

A. Eukaryotes

B. Prokaryotes

C. Neither eukaryotes nor prokaryotes

D. Both eukaryotes and prokaryotes

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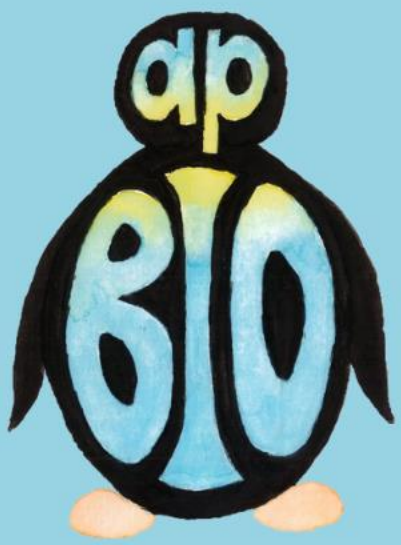

What types of cells have operons?

B. Prokaryotes

Operons are only found in prokaryotes. Operons are made up of a promoter, operator, and the genes that they control. It is a simple way for the prokaryotes to organize for gene expression.

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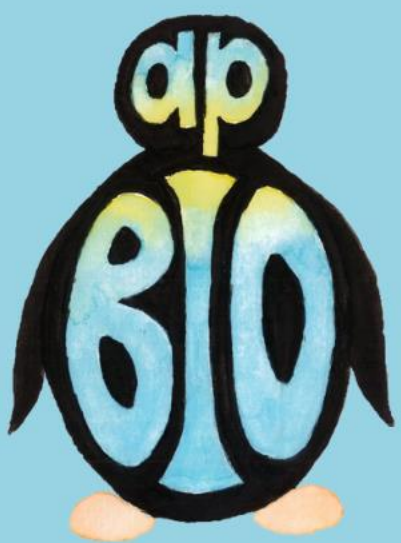

What are three components of an operon?

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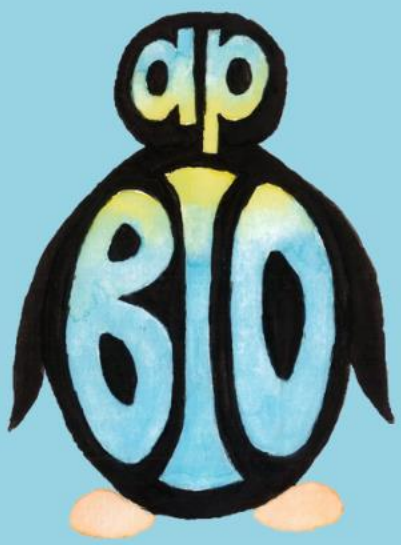

What are three components of an operon?

> Promoter

> Operator

> Genes it regulates

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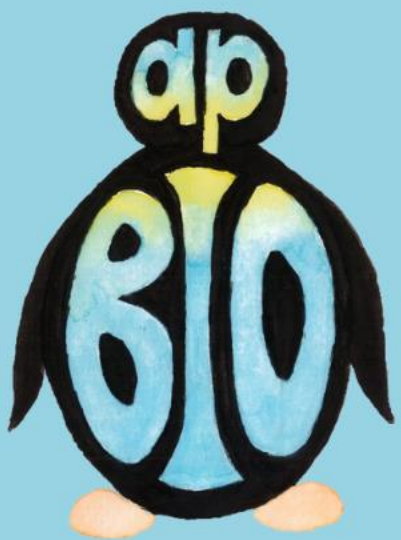

What binds to the promoter?

A. DNA polymerase

B. Operator

C. Repressor

D. RNA polymerase

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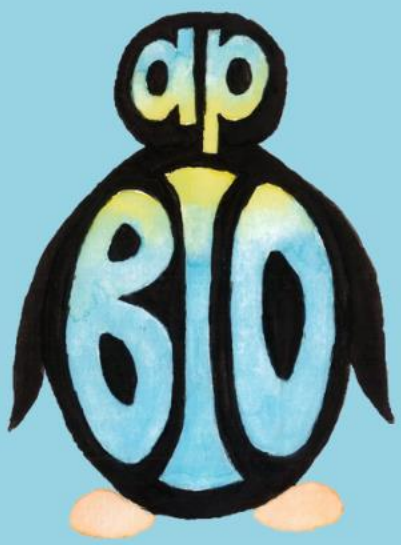

What binds to the promoter?

D. RNA polymerase

The promoter is where the RNA polymerase to initiate transcription.

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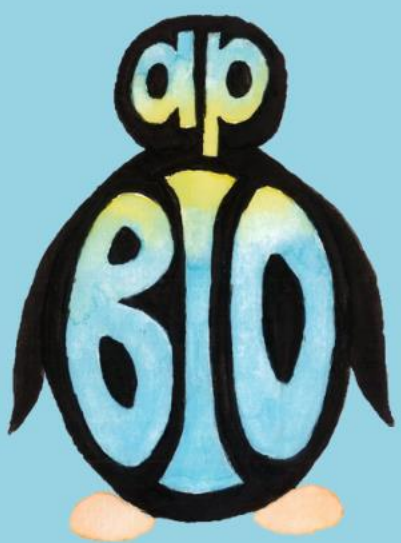

What makes up the TATA box?

A. Adenine & Cytosine

B. Cytosine & Guanine

C. Guanine & Thymine

D. Thymine & Adenine

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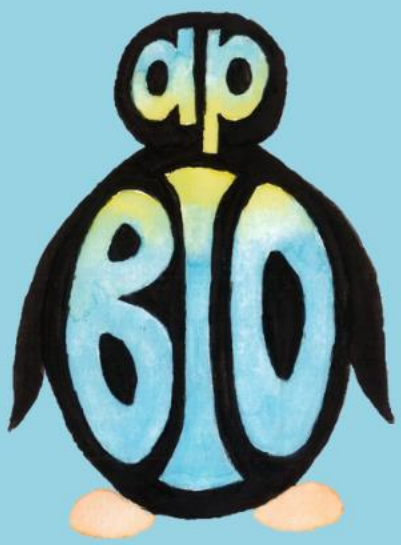

What makes up the TATA box?

D. Thymine & Adenine

The TATA box is made up of T nucleotides (thymine) and A nucleotides (adenine). This is a site on the DNA where transcription factors will bind to aid in RNA polymerase binding.

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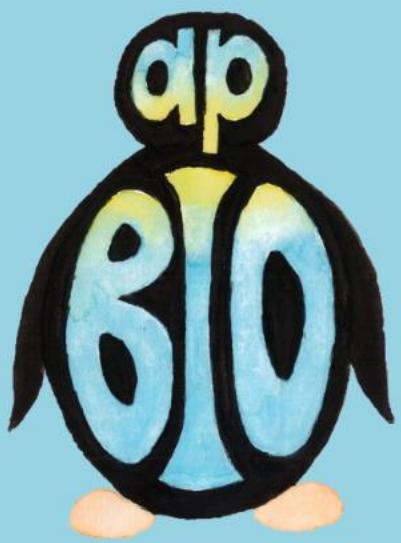

Where is the TATA box located?

A. Near the introns

B. Near the exons

C. Near the poly adenylation sequence

D. Near the promoter

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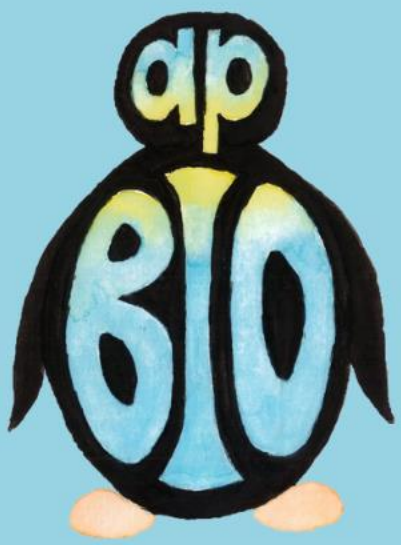

Where is the TATA box located?

D. Near the promoter

The TATA box is near the promoter. The TATA box indicates the DNA strand to be read. Transcription factors bind to this region to assist the RNA polymerase to bind to the promoter.

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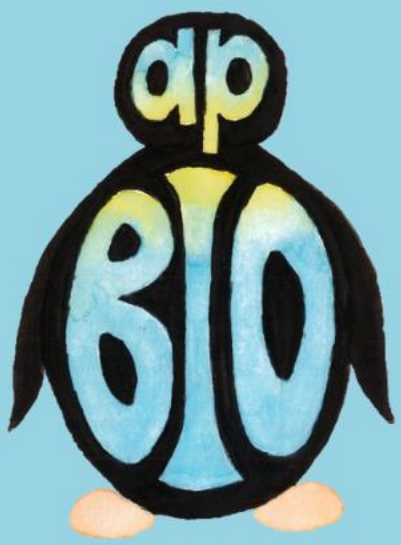

Describe the effect of adding methyl group to DNA.

A. Decreases condensation which decreases transcription

B. Decreases condensation which increases transcription

C. Increases condensation which decreases transcription

D. Increases condensation which increases transcription

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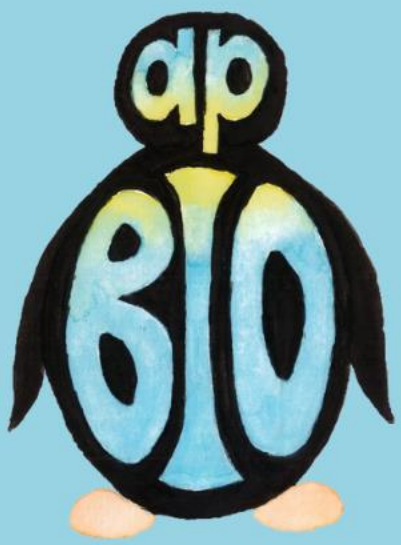

Describe the effect of adding methyl group to DNA.

C. Increases condensation which decreases transcription

Adding methyl groups to the DNA will cause the DNA to condense which decreases transcription as the RNA polymerase is unable to access the DNA to transcribe.

Recall: XX individuals will undergo methylation to their extra X chromosome to form Barr Bodies.

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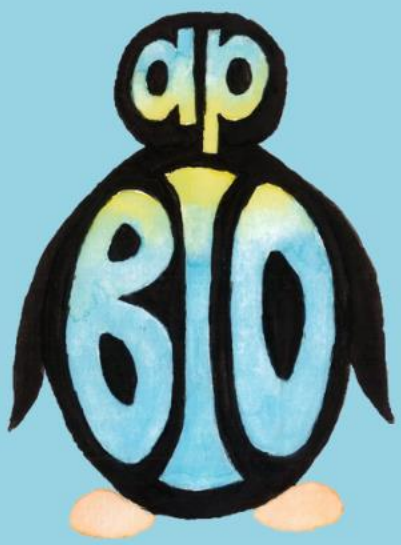

Describe effect of acetylating the histone tails

A. Decreases condensation which decreases transcription

B. Decreases condensation which increases transcription

C. Increases condensation which decreases transcription

D. Increases condensation which increases transcription

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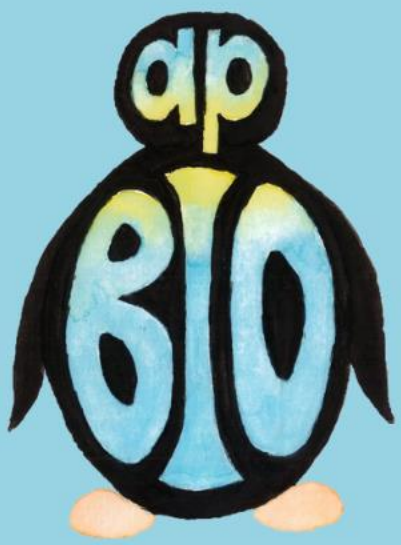
Describe effect of acetylating the histone tails

B. Decreases condensation which increases transcription



When you acetylate the histone tails, it will cause the histone to be more negatively charged. The DNA and the histone will repel causing the DNA to decrease condensation and increase transcription as the RNA polymerase is able to access the DNA for transcription.

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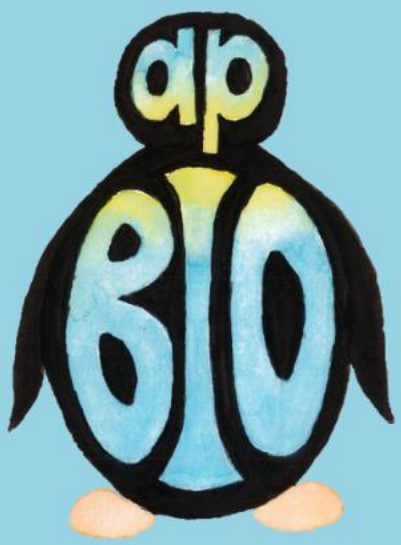

All somatic cells within one organism have the same DNA.

A. True

B. False

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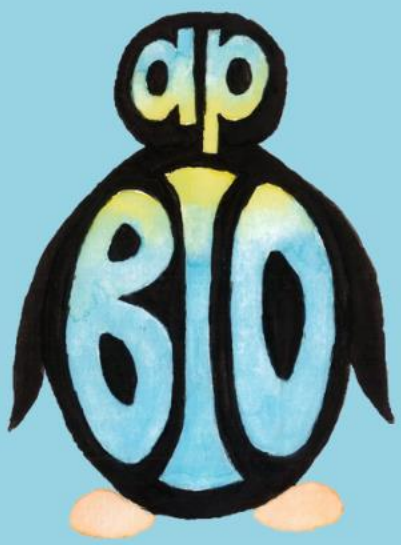
All somatic cells within one organism have the same DNA.

A. True



All cells originated from the zygote. The cells undergo mitosis forming identical cells that make up your body (somatic cells). The only cells in your body that are different are gametes due to the process of meiosis.

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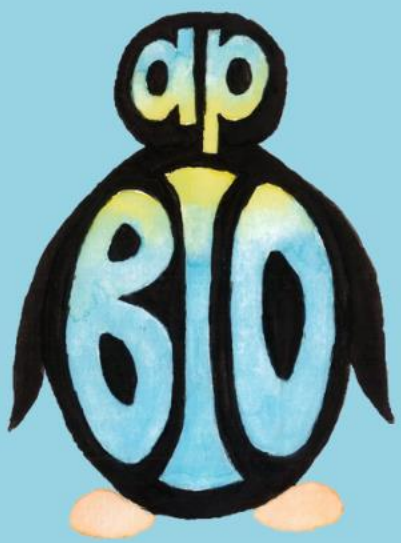

What is the function of transcription factors?

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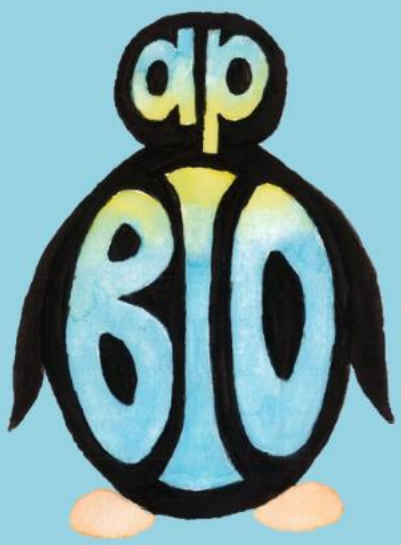

What is the function of transcription factors?

Binds to initiate transcription or inhibit transcription

Will turn on and off the genes of interest

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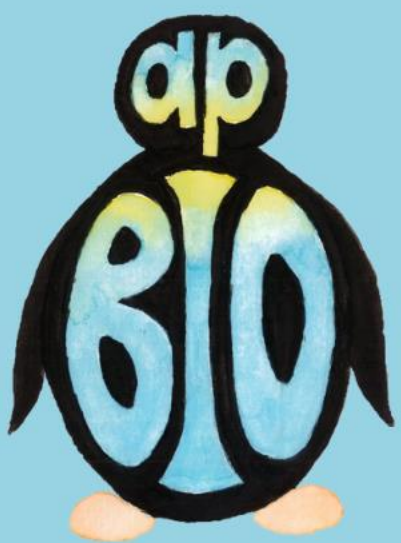

Where does the repressor in an operon bind?

A. Operator

B. Promoter

C. Regulatory sequence

D. TATA box

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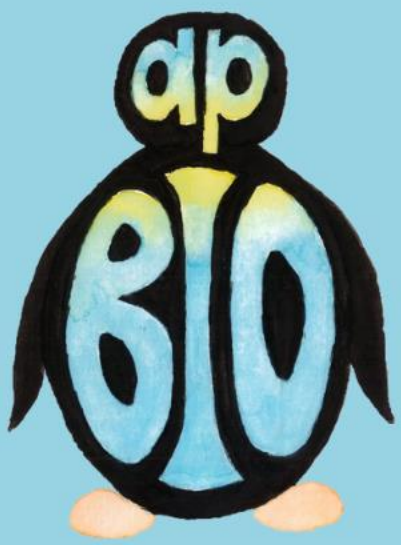
Where does the repressor in an operon bind?

A. Operator



The operator is located in the promoter region. This is the site of binding for the repressor.

If the repressor is bound to the operator, the operon will be OFF. If the repressor is NOT bound to the operator, the operon will be ON.

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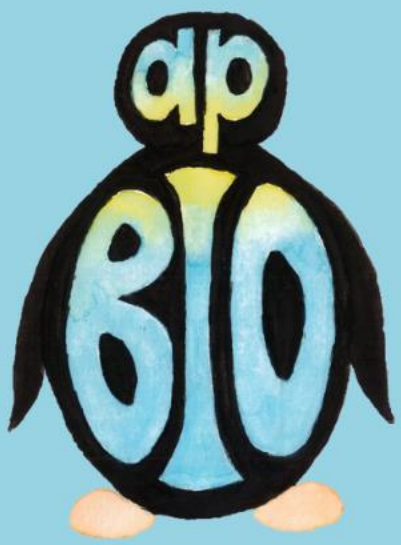

If the repressor is bound to the operator...

A. RNA polymerase is able to bind, the operon is off

B. RNA polymerase is able to bind, the operon is on

C. RNA polymerase is unable to bind, the operon is off

D. RNA polymerase is unable to bind, the operon is on

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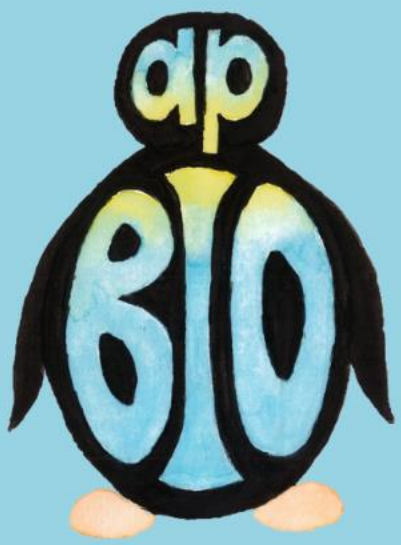
If the repressor is bound to the operator...

C. RNA polymerase is unable to bind, the operon is off



Due to the repressor binding to the operator located in the promoter region, the repressor will block the binding of the RNA polymerase. If RNA polymerase is unable to bind, transcription will be inhibited.

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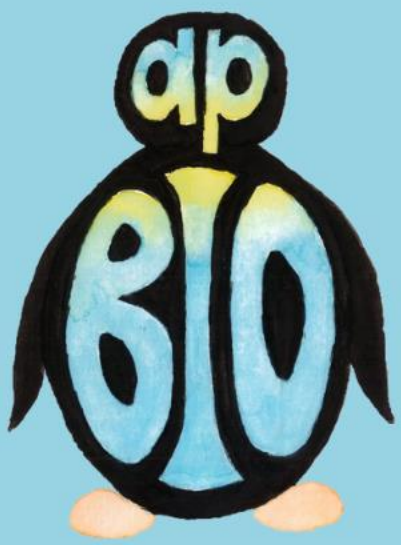

The lac operon is...

A. Inducible operon so starts off and is activated by lactose

B. Inducible operon so starts on and is deactivated by lactose

C. Repressible operon so starts off and is activated by lactose

D. Repressible operon so starts on and is deactivated by lactose

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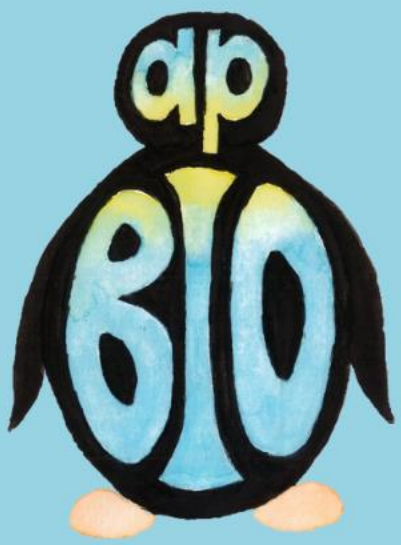
The lac operon is...

A. Inducible operon so starts off and is activated by lactose



The lac operon synthesizes the enzymes to break down lactose. This operon will start as OFF and be stimulated by the presence of lactose. The lactose acts as an inducer to deactivate the repressor and turn the operon ON. This is an inducible operon.

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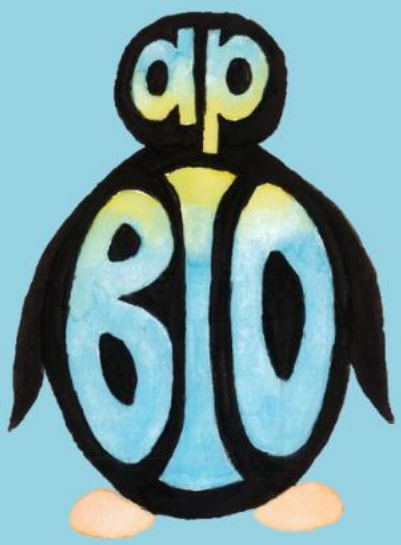

The trp operon is a(n)...

A. Inducible operon – activated by trp

B. Inducible operon – deactivated by trp

C. Repressible operon – activated by trp

D. Repressible operon – deactivated by trp

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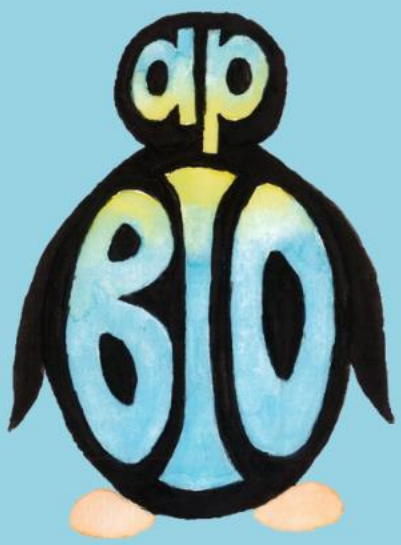
The trp operon is a(n)...

D. Repressible operon – deactivated by trp



The trp operon synthesizes the enzymes needed to synthesize tryptophan. This operon will start ON. When trp is present, it will bind to the repressor activating it so it binds to the operator to inhibit transcription and turn the operon OFF. This operon is repressible by the presence of trp.

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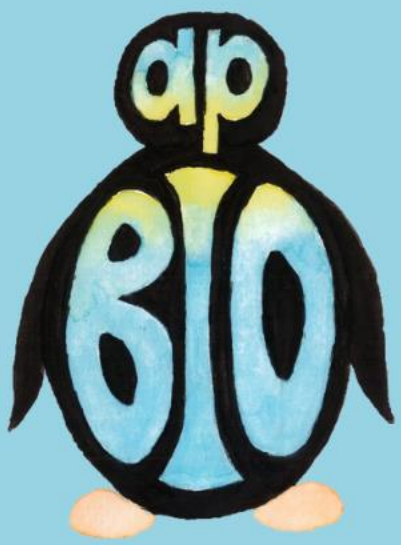

Note:

Histones are proteins that the DNA wraps around to organize it. I think of it like spaghetti (DNA) wrapped around a fork (histone) will allow you to access specific segments of the noodles versus the plate of unorganized pasta.

The histone is positively charged so attracted to DNA which is negatively charged (the phosphate groups each have 2 minus charge)