**Regulation of Gene Expression – Ch. 18**

* Genes can be **activated** by **inducer** molecules, or they can be **inhibited** by the presence of a **repressor** as they interact with **regulatory proteins** or sequences.
* A **regulatory gene** is a sequence of DNA that codes for a regulatory protein such as a repressor protein.
* How the components of an **operon** function to regulate gene expression in both **repressible and inducible operons**.
* How **positive** and **negative** **control** function in gene expression.
* The impact of **DNA** **methylation** and **histone** **acetylation** on gene expression.
* How timing and coordination of specific events are regulated in normal development, including pattern formation and induction.
* The role of **miRNAs** in control of cellular functions.
* The role of gene regulation in **embryonic** development and **cancer**.

**Regulation of Gene Expression by Bacteria**

1. *As the concentration of tryptophan protein increases, what 2 things happen to the metabolic pathway?*
2. *Is this an example of positive or negative feedback?*
* Bacteria can respond to environmental change by regulating \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (to make more or less protein/RNA)
* Bacteria have genes clustered into units called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Operons can be regulated.
	+ Turned off: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .
	+ Turned on: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**OPERON**: cluster of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ genes with on/off switch

Three Parts:

1. **P\_\_\_\_\_\_\_\_\_\_\_\_** – where \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. **O\_\_\_\_\_\_\_\_\_\_\_\_** – “\_\_\_\_\_\_\_\_\_\_”, controls access of RNA poly
3. **G\_\_\_\_\_\_\_\_\_\_\_\_** – code for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a pathway

**Draw and label a prokaryotic OPERON**



**\_\_\_\_\_\_\_\_\_\_\_ OPERON (**normally **\_\_ 🡪** can be turned **\_\_\_\_)**

1. When are the genes transcribed?
2. When is the repressor inactive?
3. When the corepressor is bound to the repressor, what happens?
4. When is transcription off/stopped?



* Normally \_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (builds organic molecules)
* Organic molecule product acts as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 🡪 binds to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ protein to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ it
* Operon is turned OFF
* Eg. ***\_\_\_\_\_* operon**
1. What is the co-repressor?
2. How does an increase in tryptophan alter transcription (gene expression)?

**Summarize why the *trp* operon is a repressible operon.** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**\_\_\_\_\_\_\_\_\_\_\_\_\_ OPERON (**normally **\_\_\_\_ 🡪** can be turned **\_\_\_)**

1. When is transcription off/stopped?
2. When is the repressor inactive?
3. When the inducer is bound to the repressor, what happens?
4. When are the genes transcribed?



* Normally \_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (break down food for energy)
* Repressor is active 🡪 **\_\_\_\_\_\_\_\_\_\_\_\_\_** molecule binds to and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** repressor protein
* Operon is turned \_\_\_\_ and RNA polymerase can transcribe genes
* Eg. ***\_\_\_\_\_\_* operon**
1. What is the inducer?
2. How does the inducer inactivate the repressor?
3. When is the lac operon “off”?

Summarize why the *lac* operon is an inducible operon. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Gene Regulation: Positive vs. Negative Control**

* *Negative control*: operons are switched \_\_\_\_\_ by active form of repressor protein
	+ Eg. *trp* operon, *lac* operon
* *Positive control*: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ protein interacts directly with genome to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ transcription
	+ Eg. cAMP & CAP

**cAMP + CAP = Positive Control**

* cAMP: accumulates when \_\_\_\_\_\_\_\_\_\_\_\_\_ is scarce
* cAMP binds to CAP (catabolite activator protein)
* Active CAP 🡪 binds to \_\_\_\_\_\_\_\_ upstream of promoter, **\_\_\_\_\_\_\_** affinity of RNA polymerase to promoter, **\_\_\_\_\_\_\_** transcription



**Summarize** in your own words why this is an example of POSITIVE FEEDBACK CONTROL.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. When is CAP active?
2. When CAP is active, what does it do?
3. When is the lac operon “on”?
	1. Is it when lactose levels are high or low?
	2. Is it when glucose levels are high or low?

**Amoeba Sisters Video Notes:** [***Gene Expression and the Order of the Operon***](https://www.youtube.com/watch?v=h_1QLdtF8d0&index=30&list=PLwL0Myd7Dk1F0iQPGrjehze3eDpco1eVz)