**Prokaryotic Gene Regulation**

**PhET Simulation of Operon Function**

The purpose of this activity is to develop an understanding for how prokaryotes control gene expression. In 1961, Francois Jacob and Jacques Monod proposed the operon model of gene regulation in bacteria. The model was based on their study of the genes in *E. coli* that code for enzymes that affect the breakdown of lactose.

Because of the pioneering work of Jacob and Monod, the *lac* operon is typically used to illustrate gene regulation in bacteria. Gene regulation in eukaryotes is quite different.

Click [Here](https://phet.colorado.edu/en/simulation/gene-machine-lac-operon) to get to the Gene Machine: The Lac Operon simulation. You will need to download and run the Java program and this will require you to be patient. Once the Java window is open you should see an image like the one below. Now you are ready to begin the simulation.



1. Drag the ***lac promoter*** to the appropriate location on the stretch of DNA. Wait a few seconds, then describe what happens.

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1. Now drag the ***lacZ gene*** to the appropriate location on the stretch of DNA. Wait a few seconds, then describe what happens.

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1. In the upper left-hand corner, there is a tool that allows you to inject lactose into the environment. Click on the red button to manually inject 20-25 lactose molecules. Wait a few seconds, then describe what happens.

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1. Note that the lacZ gene continues to be transcribed and translated even in the absence of lactose. Why is this a problem for the *E.coli* cell?

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1. Drag the ***lac operator*** to the appropriate location on the stretch of DNA. Wait a few seconds, then describe what happens.

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1. Now drag the ***lacI promoter*** AND ***lacI gene*** to the appropriate location on the stretch of DNA. Wait a few seconds, then describe what happens.

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1. Again, add some lactose to the environment. Describe the result of adding lactose.

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1. What happens when the lactose is removed from the environment?

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1. Click on the **Lactose Transport** tab at the top of the screen. Drag all of the operon elements to their appropriate locations on the stretch of DNA. Wait several seconds until the manual lactose pump appears. Add 20-25 lactose molecules. Describe the role of the ***lacZ gene*** and the ***lacYgene***.

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1. Why do you think these genes located next to one another and controlled by the same operator/promoter?

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