

Gene Machine - The Lac Operon

Talk to a Teacher

<http://spoken-tutorial.org>

National Mission on Education through ICT

<http://sakshat.ac.in>

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7 February 2017



Learning Objectives



Learning Objectives

- ▶ **Demonstrate Gene Machine - The Lac Operon, PhET Simulation**



Pre-requisites



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- ▶ **Learner should be familiar with topics in high school Biology**



System Requirement



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- ▶ **Ubuntu Linux OS v 14.04**



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- ▶ **Java v 1.7.0**



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- ▶ **Ubuntu Linux OS v 14.04**
- ▶ **Java v 1.7.0**
- ▶ **Firefox Web Browser v 53.02.2**



Learning Goals



Learning Goals

- ▶ **Lactose regulation**



Learning Goals

- ▶ **Lactose regulation**
- ▶ **Genes involved in Lactose regulation**



Learning Goals

- ▶ Lactose regulation
- ▶ Genes involved in Lactose regulation
- ▶ Factors affecting **LacZ** gene regulation



About Lac Operon



About Lac Operon

- ▶ The **Lac Operon** is a set of genes responsible for regulating lactose metabolism in *E.coli* bacteria



Components of Lac Operon



Components of Lac Operon

An operon is made up of 3 basic DNA components:



Components of Lac Operon

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- ▶ **Promoter:** Initiates transcription



Components of Lac Operon

An operon is made up of 3 basic DNA components:

- ▶ **Promoter:** Initiates transcription
- ▶ **Operator:** Segment of DNA where repressor binds



Components of Lac Operon

An operon is made up of 3 basic DNA components:

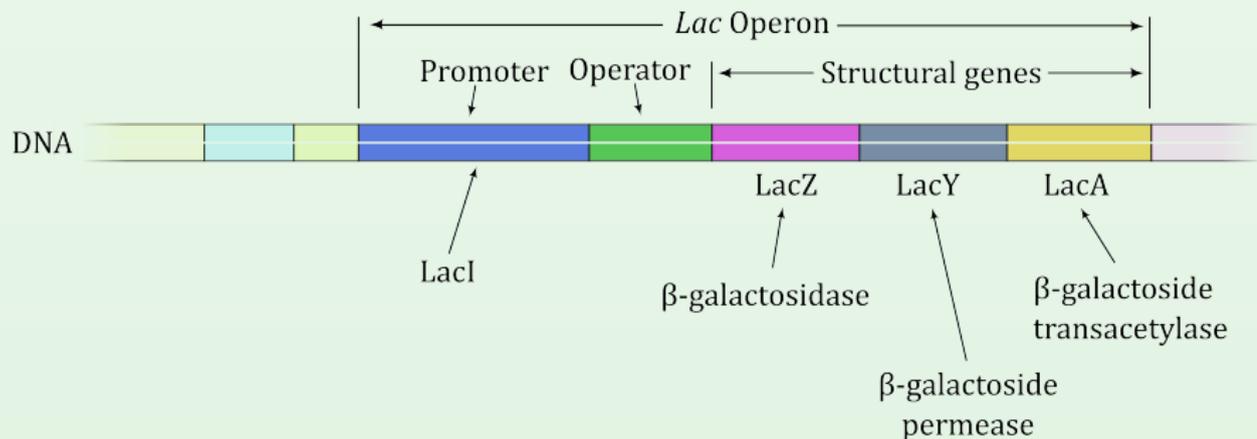
- ▶ **Promoter:** Initiates transcription
- ▶ **Operator:** Segment of DNA where repressor binds
- ▶ **Structural gene:** A gene which codes for protein



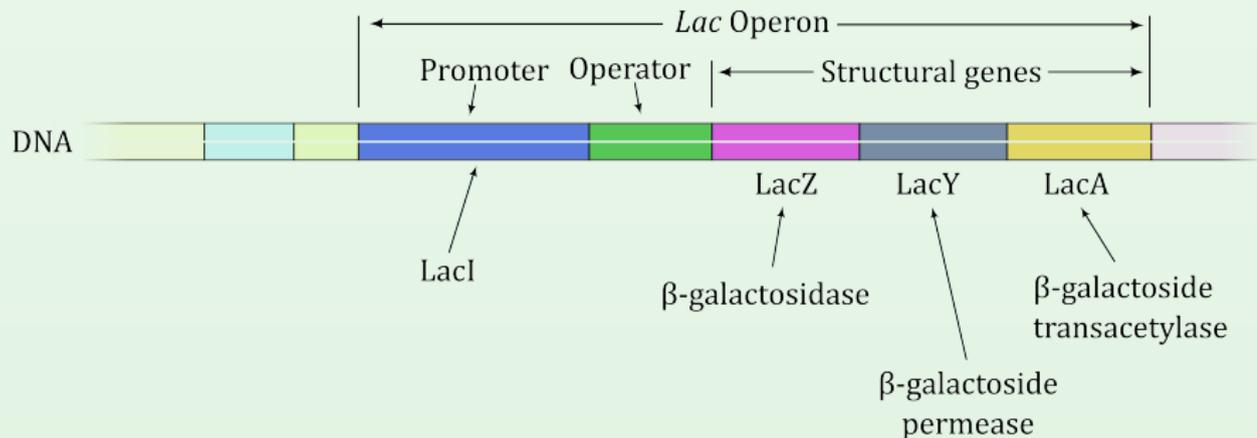
Structural Gene



Structural Gene



Structural Gene



PhET Simulation-Link



PhET Simulation-Link

<https://phet.colorado.edu>



LacI Protein



LacI Protein

- ▶ **LacI** is a **Lac repressor protein**



LacI Protein

- ▶ **LacI** is a Lac repressor protein
- ▶ It binds to the Lac operator region of the Operon



LacZ Protein



LacZ Protein

- ▶ **LacZ** is β – *galactosidase* enzyme



LacZ Protein

- ▶ **LacZ** is β – *galactosidase* enzyme
- ▶ It cleaves lactose into glucose and galactose



LacY Protein

- ▶ **LacY** is β – *galactoside permease* enzyme



LacY Protein

- ▶ **LacY** is β – galactoside permease enzyme
- ▶ It enables transport of lactose into the cell



Factors affecting LacZ gene regulation



Factors affecting LacZ gene regulation

- ▶ **The lac repressor acts as a lactose sensor**



Factors affecting LacZ gene regulation

- ▶ **The lac repressor acts as a lactose sensor**
- ▶ **It blocks transcription of the Lac Operon when there is no lactose present in the cell**



Factors affecting LacZ gene regulation



Factors affecting LacZ gene regulation

- ▶ **When lactose is present, the lac repressor loses its ability to bind DNA**



Factors affecting LacZ gene regulation

- ▶ When lactose is present, the lac repressor loses its ability to bind DNA
- ▶ It floats off the operator, clearing the way for RNA polymerase to transcribe the Operon



Summary



Summary

- ▶ **How to use Gene Machine-The Lac Operon, PhET simulation**



Summary



Summary

- ▶ Lactose regulation
- ▶ Genes involved in lactose regulation
- ▶ Factors affecting **LacZ** gene regulation



Assignment



Assignment

1. Remove some of the components of Operon (Operator, Promoter and Genes)
2. Run the simulation
3. Observe the results and give explanation



About the Spoken Tutorial Project

- ▶ Watch the video available at http://spoken-tutorial.org/What_is_a_Spoken_Tutorial
- ▶ It summarises the Spoken Tutorial project



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- ▶ If you do not have good bandwidth, you can download and watch it



Spoken Tutorial Workshops

The Spoken Tutorial Project Team

- ▶ Conducts workshops using spoken tutorials
- ▶ Gives certificates to those who pass an online test
- ▶ For more details, please write to contact@spoken-tutorial.org



Forum for specific questions

- ▶ Do you have questions in **THIS Spoken Tutorial?**
- ▶ Please visit
<http://forums.spoken-tutorial.org>
- ▶ Choose the minute and second where you have the question
- ▶ Explain your question briefly
- ▶ Someone from our team will answer them



Acknowledgements

- ▶ **This project is partially funded by Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching**



Acknowledgements

- ▶ Spoken Tutorial Project is a part of the Talk to a Teacher project
- ▶ It is supported by the National Mission on Education through ICT, MHRD, Government of India
- ▶ More information on this Mission is available at

<http://spoken-tutorial.org/NMEICT-Intro>

