Controlling the Code: molecules at work

The lac operon

A living organism can be distinguished from something that is nonliving by its ability to carry out life processes, maintain a stable internal environment, and pass on hereditary information through reproduction. Despite lacking all of the levels of organization present in a complex, multicellular organism, a single-celled organism can function very successfully.

1. Go to ***DNAi*** **(www.dnai.org) > Code > Controlling the Code**. Work through the *problem, players, pieces of the puzzle* and *putting it together* sections of this module.
2. Write a description of the role of the operator in *B*-gal production.

   Be sure to provide the following in your narration:

   - What is the operator?
   - When is the repressor protein bound to the operator?
   - When does transcription occur? Why?
   - What is the role of lactose in the initiation of transcription?
   - How does feedback (both negative and positive) regulate the production of *B*-gal?

Molecules for hire

Pretend that you are the bacterium *E. coli*. To survive, you must have a system to transport the sugar lactose across your cell membrane to use it as food. You need the enzyme *B*-gal (beta-galactosidase) to process the lactose. You must continually produce *B*-gal molecules when lactose is present, because they eventually break down. However, producing *B*-gal molecules when they have no "job" to do is wasteful of your energy and materials. Your cellular efficiency is critical, so you should only "turn on" production of the enzyme *B*-gal when lactose is present, and "turn off" production when lactose is not present.

You will be "hiring" specific regulatory molecules to control your lactose usage operations, choosing certain "employees" that are critical to making this process efficient. Read through the "Work Wanted" ads that follow and decide which candidates are potential employees in your lactose regulation division. Keep in mind that some of the job seekers are not qualified!

1. Go to **www.dnai.org > Code > Controlling the Code**. The *pieces of the puzzle* will provide you with the hiring information you need.
2. Circle the number of each "Work Wanted" advertisement that accurately describes a part of the regulation of gene transcription associated with the production of *B*-gal.
3. Several important players in the synthesis of *B*-gal have been omitted from the "Work Wanted" ads. Messenger RNA is one of them.
   (a) Complete the Work Wanted posting for mRNA. Be sure to include its role in *B*-gal production and "who" it associates with during the process.
   (b) Add the information to the "Work Wanted" ad sheet.

Work Wanted

Advertisements by experienced molecules, genes, and newcomers.

FREE ADVERTISEMENTS for experienced molecules, genes, and molecular newcomers looking for a chance to become professional cell regulators.

Seeking Operon Position
Ad #1011
I'm looking for responsibility as a gene. I have extensive experience working with one or more other genes so closely that our work appears to be the product of a single gene. I'm excellent at waiting my turn, good at transcription, efficient and thorough. I am suited to the operon role as I am trusted to perform my task only when requested. For a copy of a resume and application letter I have prepared, please contact me Henrietta Lac at e-mail: Hlac@CellsRUs.edu.

Seeking Operon Position
Ad #1022
I am a gene specializing in communication. I have recently received my license to operate independently of other genes and I am currently seeking an individual cell or group of cells to work with. My main interest would be in the area of locating assets such as glucose and lactose and conducting relationship investigations. I work best independently. For a copy of my resume and references contact me, Ima Gene at 4288 Coliform Cove, Dysentery, NY.

Seeking Repressor Position
Ad #1111
Looking for occasional work with lactose molecules in a cellular environment. Am able to change shape with changing conditions. I can bind to either DNA or lactose. I am most active when lactose is absent. Have experience working with gene operators and mRNA. E-mail address: OffAndOn@cellmail.edu.

Inhibitor Work Wanted
Ad #1112
Work needed. DNA literate. I have an excellent relationship with lactose. Quality customer service abilities. Can work with tRNA, mRNA, and ribosomes. I can be counted on to never change shape. Contact information: Polly Protein, 10 Ribose Lane, Watson, NY.

Experienced Promoter Seeks Position
Ad #1122
Even though I am a short stretch of DNA nucleotides, I am accustomed to being in control. I am willing to work closely with RNA polymerase and take directions from an operator. Call me at Nosoy Shake, 100 Angstrom Ct., Diffraction City, NJ.

Messenger RNA Seeks Steady Work
Ad #1133