Hi guys! Welcome back to another resource. I hope you all enjoyed your Thanksgiving break and caught up on your rest. Hopefully you are ready to tackle the last few weeks of the semester! This is the last “normal” resource before the final review resource that will cover the most important topics from the entire semester. Here we go! This is your weekly reminder that I hold weekly group tutoring sessions on Thursdays from 5:15—6:15 pm in room 75 in the basement of Sid Rich. Sign up to join the session here: https://baylor.edu/tutoring. I would love to see you there!

**Keywords:** Operons, Gene Regulation, Differential Gene Expression, Cancer

**Topic of the Week: Operons**

**Operon:** A *unit of genetic function* found in *bacteria and phages*, consisting of a promoter, an operator, and a *regulated section of genes*

Operons are found *only in bacteria!* The genes grouped together are grouped based on their *functions!* This is convenient because a single switch can turn the genes on or off depending on what is needed for the cell at the time.

**Terms related to operons**
- **Operator:** sequence of nucleotides at the beginning of the operon where the repressor can attach. The repressor prevents the binding of RNA polymerase from attaching to the promoter and continuing transcription
- **Repressor:** protein that inhibits gene transcription. They bind to DNA near the promoter
- **Regulatory gene:** encodes for the repressor protein
- **Corepressor:** small molecule that binds to a repressor and changes its shape allowing it to bind to the operator

Below are photos of the *trp (tryptophan) operon*, a commonly studied operon in bacteria that shows the basic functions of many components of operons
HIGHLIGHT #1: Regulation of Chromatin Structure

Remember that DNA is packed with proteins into chromatin! The structure of chromatin helps to regulate gene expression.

Chemical modifications of histones play a role in gene regulation
- **Histone acetylation**: addition of an acetyl group to amino acids of histone tails
  This *promotes* transcription by opening the chromatin up
- **DNA methylation**: addition of methyl groups on the DNA bases (usually cytosine)
  Can *promote* or *inhibit* transcription

HIGHLIGHT #2: Differential Gene Expression

There are many different things that contribute to the different cell types that we have in our bodies. Here are a few terms to be familiar with:
- **Differentiation**: process by which a cell or group of cells becomes specialized in structure and function
- **Cytoplasmic determinants**: maternal substance like protein or RNA that influences early development by regulating gene expression that affect development of cells
**Induction:** the process through which a group of cells influences the development of another group of cells

**Determination:** the point at which an embryonic cell is committed to becoming a specific cell type

**Pattern formation:** development of an organism’s spatial arrangement of organs and tissues

Overall, the story here is that cells in embryos are committed to becoming certain types of cells in the future that are specialized for specific functions. The cells all have the same genome, but have different functions based on the differences between what genes are expressed. Cytoplasmic determinants in an egg are evenly distributed daughter cells in order to regulate expression of these genes to make sure the cells stay on the path towards their fate. The cells differentiate into different tissues.

**HIGHLIGHT #3: Cancer**

We have discussed how cells divide and we have touched on what happens when mistakes are made when DNA is replicated. Let’s look at a few more terms that are important to know regarding genes that are associated with cancer.

- **Oncogenes:** gene involved in triggering molecular events that can lead to cancer
- **Proto-oncogenes:** normal genes that may potentially become oncogenes
- **Tumor suppressor genes:** gene whose protein product inhibits cell division which prevents uncontrolled cell growth that can lead to cancer

Here are some ways in which proto-oncogenes can be turned into oncogenes:
Cancer has a method of growing. There is a model of this multistep pathway that is shown through the development of colorectal cancer.

This emphasizes the fact that many changes have to occur in order for a cell to be considered fully cancerous.

CHECK YOUR LEARNING
1. True or false: An operator is a group of genes clustered together that can be regulated in prokaryotes.
2. How are histone acetylation and DNA methylation similar? How are they different?

THINGS YOU MAY STRUGGLE WITH
1. It is important to understand the difference between differentiation and determination. Differentiation is the process by which cells separate into their respective tissues. Determination occurs early on in the embryo where the cells are assigned a specific developmental fate.
2. Many students struggle with the operon concept. Make sure you understand what the terms mean separately before you put them together and look at the overall concepts.