Unit 4: Molecular Genetics
Content Outline: DNA Control Mechanisms (4.3)

I. DNA control mechanisms in Prokaryotic cells only
   A. **Operon System** "operator"
      1. Francois Jacob and Jacques Monod discovered this control mechanism.(1961)
      2. **Operon** "operator" *controls* RNA Polymerase *access* to the DNA strand.
      3. *Operon* is part of the **promoter** sequence. It is located between the TATA box and Start codon.
      4. **Repressor** and **co-repressor** - These *molecules* act as an "off "switch.
      5. **Inducer** - This *molecule* acts as an "on" switch.
      6. These are *both* Negative Feedback loops. (They stop a process that is occurring, and gets it going in the opposite direction.)
      7. These are considered *regulatory genes* as well.

II. DNA *Control Mechanisms in* all *cells* (Remember, these are ways to *control* Gene Expression.)
   A. **Transposons** "Jumping Genes" (These DNA *segments* act as *"Blockers"* to transcription.)
      1. Barbara McClintock discovered this control mechanism in the1940's. She worked with Maize. She won a Nobel Prize for this work.
      2. Two types of transposons that exist:
         a. Basic Insertion
            i. This is the *simplest* form.
            ii. **Transposase** – enzyme that allows the DNA *to "jump" from location to location.*
      3. This is another example helping to show *common ancestry* among all the life forms on Earth.

III. DNA *control* mechanism in Eukaryotes mainly.
   A. DNA that is *wound up*, like for Mitosis, is not able to be Transcribed. The enzyme transcription "factory" can't be built because it *cannot* get access to the DNA strand.
   B. DNA that is *unwound*, like in G1 of Interphase, is able to be Transcribed. The enzyme transcription "factory" *can* be built because it *can* get access to the DNA strand.
   C. Remember, Eukaryotic cells can also control the *removal of introns and rearranging of exons* in post translation modification.
   D. Lastly, did the protein require a **chaperonin** or the **Rough Endoplasmic Reticulum (RER)** for folding up into its 3D shape?
      1. Proteins that use **chaperonins** stay *inside* the cell, such as enzymes or cytoskeleton parts.
      2. Proteins that use **RER** *exit* the cell, such as for communication or protection by the Extra Cellular Matrix (ECM).

IV. *The genes that are transcribed help determine what the cells will mature into over time.* In other words, when cells "grow up" the will carry out "adult" functions. We call "adult" cells **specialized** or **differentiated**. They can carry out special or different functions. What do you want to be when you grow up?

It is extremely important that students understand the various ways of controlling protein expression in all cells. Students should be able to make the connection to the ability to make a protein and seeing that phenotype in organisms' as the next unit is Mendelian genetics. Traits are the result of gene expression or also the lack of expression. These traits may then be needed to help organisms survive their environment – Natural Selection. Please make sure students can understand this big picture concept as you progress through the next couple of units. It all starts her in Molecular genetics, that is why we chose to put this unit first.