1. **Regulation of Gene Expression**
   Chapter 9
2. **9.1 Major Modes of Regulation**
   - Enzyme activity
   - Enzyme amount
3. **9.2 DNA-Binding Proteins**
   - Non-sequence specific
     - Histones
   - Sequence specific
     - Inverted repeats
4. **9.3 Negative control**
   - Transcription level
     - Stops transcription
       - RNA polymerase binding repressed
       -
   - Inducible
     - Excess substrate (turns on)
       - Prevents repressor binding
       -
   - Repressible
     - Excess product (turns off)
       - Allows repressor binding
5. **9.3 Negative control**
   - Transcription level
     - Stops transcription
       - RNA polymerase binding repressed
   - Inducible
     - Excess substrate (turns on)
       - Prevents repressor binding
   - Repressible
     - Excess product (turns off)
       - Allows repressor binding
6. **9.4 Positive Control**
   - Transcription level
     - Activates transcription
       - RNA polymerase binding enhanced
   - Inducible
     - Excess substrate (turns on)
       - Allows activator binding
   - Repressible
     - Excess product (turns off)
       - Prevents activator binding
7. **9.4 Positive Control**
   - Transcription level
     - Activates transcription
       - RNA polymerase binding enhanced
   - Inducible
     - Excess substrate (turns on)
       - Allows activator binding
   - Repressible

This is only a guideline topics discussed in-class as well as the assigned pages from the text and supplemental material may also be on the exam.

- Excess product (turns off)
  - Prevents activator binding

8 **9.5 Two-Component Regulatory Systems**
- Prokaryotes regulate metabolism in response to environment
- signal not always transmitted directly
- *Signal transduction*:
  - detected by sensor & transmitted
  - Most are *two-component regulatory systems*

9 **9.5 Two-Component Regulatory Systems**
- two proteins
  - *Sensor kinase*:
    - detects signal & autophosphorylates
  - *Response regulator*:
    - DNA-binding protein that regulates transcription
  - Absent in bacteria that live as parasites of higher organisms

10 **9.5 Two-Component Regulatory Systems**
- ~ 50 different two-component systems in *E. coli*
  - phosphate assimilation, nitrogen metabolism, & osmotic pressure response

11 **9.6 Quorum Sensing**
- response to other cells of the same species
- *Quorum sensing*:
  - bacteria assess their population density
  - Ensures sufficient number of cells are present
    - toxin production in pathogenic bacterium

12 **9.6 Quorum Sensing**
- Each species produces specific *autoinducer* molecule
  - Diffuses freely
  - high concentrations only if many cells are near
  - Binds to activator protein & triggers transcription
    - *Acyl homoserine lactone*
    - *V. fischeri*
      - *Lux operon*

13 **9.6 Quorum Sensing**
- Examples of Quorum Sensing
  - *P. aeruginosa* from free living to growing as a *biofilm*
  - Virulence factors of *S. aureus*

14 **9.7 Regulation of Chemotaxis**
- Modified two-component system used in *chemotaxis*
  - Sense changes in attractants or repellents
  - Regulate flagellar rotation
- Three main steps
  1) Response to signal
  2) Controlling flagellar rotation
  3) Adaptation

15 **9.9**
- Glucose always used first
  - Catabolite repression
  - Catabolite activator protein (CAP)

16 **9.9 lac Operon**
- Operon
- *E.coli* (negative inducible)

17 **9.11 Global Control Networks**
- Heat shock proteins
  - Sigma factors σ^{70}
    - Involved σ in normal gene transcription
  - Alternative sigma factors σ^{32}
    - Normally degraded quickly
  - Stress
    - Prevents degradation
  - σ^{32}
    - Controls genes which code for proteins that assist in recovery

18 **9.14 & 15 RNA Regulation & Riboswitches**
- Small RNA's (sRNA)
  - Antisense
  - Double stranded RNA
- Riboswitches
  - Cofactor regulation
    - Thiamine
    - Riboflavin
    - B12
  - Metabolite binds RNA

19 **9.16 Attenuation**
- Control occurs after initiation of transcription
  - Before it is complete
- Number of completed transcripts is reduced
- Tryptophan operon

20 **In-Class Assignment**
- Draw and explain in your own words the following regulatory mechanisms:
  - Negative control
    - Repression
    - Induction (lac Operon)
  - Positive control
    - Repression
    - Induction
  - Catabolite repression