Micro 2054 - Microbial Genetics
1953 – James Watson, Francis Crick, and Maurice Wilkins discovered structure of DNA

Genetic Molecules in a Prokaryotic Cell
Bacterial Genome – DNA, usually circular, sometimes linear, 1500X the cell length
Plasmid – extrachromosomal circular, double stranded DNA
- much smaller than a genome, not found in all bacteria
- usually transferred by conjugation
- supplies a genetic advantage to the cell
- can carry genes for antibiotic resistance, resistance to toxic metals, metabolism of unusual food sources, pathogenesis genes, etc.

Structure of Genetic Molecules
DNA – genome (chromosome), plasmids
  1. sugar (deoxyribose) - phosphate backbone
  2. 4 bases – paired in the double-stranded molecule
cytosine – guanine
adenine – thymine
  3. double-stranded (2 sugar-phos backbones that are antiparallel), helical
exception – some SS-DNA viruses
  4. carries the genetic code (Codon – 3 bases code for an amino acid)

RNA
  1. sugar (ribose) - phosphate backbone
  2. 4 bases
  adenine, cytosine, guanine, uracil (instead of thymine)
  3. single-stranded

Types of RNA - used to produce proteins from the DNA base sequence
mRNA (messenger RNA) - carries the gene sequence to be converted to protein
rRNA (ribosomal RNA) - part of the ribosome needed for translation
tRNA (transfer RNA) – carries amino acids to the ribosome

Other types of RNA - regulate transcription:
snRNA (small nuclear RNA): RNA splicing in eukaryotes, archaea
miRNA (microRNA) - regulate transcription in eukaryotes

Genetic Processes In The Cell
These are repetitive processes – All these processes require a lot of energy.
1. Initiation – start of synthesis
2. Elongation – make DNA, RNA, or protein molecules
3. Termination – release of the product and machinery.

DNA Replication – necessary for cell division
- process to make an exact copy of the DNA genome for each daughter cell
- DNA polymerase – enzyme that performs DNA synthesis
- two replication forks move around the genome
Transcription
- process to make an RNA copy of the DNA molecule
- RNA polymerase – enzyme that makes an RNA copy from the DNA template
- sigma factor needed for initiation – guides the RNA Pol to the target DNA sequence

Translation
- process to make a protein (chain of amino acids) from the mRNA copy
- uses the genetic code (codon-three bases) to convert the base sequence to an amino acid sequence
- requires ribosomes that bind to the mRNA and allow tRNA to interact with mRNA

In prokaryotic cells – coupling of transcriptional and translation (advantage of not having a nucleus).

Methods Of Genetic Exchange In Prokaryotic Cells
DNA sequence in cells is always changing because of Lateral Gene Transfer (genes exchanged between cells)
1. Transformation
   - uptake of “naked” DNA by receptive cells
   - uses a transformasome (in the envelope or cell membrane)
   - cells must be competent – log phase, protein factors are also involved
   - replaced by electroporation (lab machine that uses an electrical charge)
2. Transduction
   - phage (bacterial virus) transfers DNA from one bacterium to another
   - “wrong” DNA gets packaged into the viral capsid
3. Conjugation
   - transfer of DNA by direct contact between a donor cell and recipient cell
   - often requires a sex pilus – pulls recipient to the donor
   - transfer plasmid, sometimes with genomic DNA attached to it

Defenses against Foreign DNA Invasion (phage defense)
- restriction endonucleases, which cut DNA at specific sites called palindromes
  - these enzymes are also used in recombinant DNA technology
- cell’s genome is protected (methylated at these palindromic sites)

Homogenous Recombination – entering DNA can replace genomic DNA sequences

Transposons (Tn) – segments of DNA that can move from one DNA molecule to DNA molecule (including moving on and off plasmids)
- Tn have an enzyme called transposase that an make a copy that inserts into any DNA molecule