**Module 6 – Microbial Genetics**

**Chapter 8**

**Structure and function of the genetic material**

- Genetics – science of _____
    - Study of what genes are, how they determine the characteristics of an organism, how they carry information, how the information is copied, how information is passed on to subsequent generations and between organisms
- Genome: all the _____ in a cell
    - Includes _____ and _____
- Genomics: _____, characterization of genomes
- Chromosomes: a structure that _____ the _____
    - Physically carries the _____, genes
    - Bacteria typically have _____
- DNA is twisted and _____ to fit into cell
    - DNA is _____ longer than entire cell
- Genes: segments of DNA that _____ to produce _____
- Genetic code: the set of rules that determines how a nucleotide sequence is converted into _____
    - _____ of nucleotides provides the information for making proteins
- Much of anabolism is making _____
    - When product is made from a gene, the gene is _____
- Genotype: an organism's _____
    - The information _____
    - Represents _____ characteristics
- Phenotype: and organism's _____ properties
    - Eg, _____
- Phenotype is the display of _____
    - Genotype is _____
    - Phenotype is _____

**DNA**

- Polymer of _____:
- Strands are held together by _____
    - _____ and _____
- Strands are _____

**DNA Replication**

- One _____ DNA molecule converted into 2 identical _____ molecule
    - Parental DNA strand acts as _____

*Process of DNA replication*

- Double stranded DNA molecule unwound by _____ enzyme

- Exposed bases matched up with _____ in cytoplasm
- *DNA polymerase* _____ to forming DNA molecule
- Each new DNA molecule contains one _____ strand, one _____ strand → _____ replication

**RNA and Protein Synthesis**

- Genetic information from DNA follows the "_____"
  - _____ is used to make _____, which is used to make _____
  - _____
- _____ → _____: _____, _____ synthesis
- _____ → _____: _____, _____ synthesis

*Transcription*

- _____ of _____
  - Using _____ as a _____
- Recall, RNA is _____ stranded, uses _____ instead of T
- Three kinds of RNA:
  - Ribosomal RNA, rRNA: _____ part of _____
  - Transfer RNA, tRNA: involved in _____
  - Messenger RNA, mRNA: carries _____ for making _____
- mRNA is synthesized from a gene by enzyme called _____
- Transcription begins when _____ binds to the _____ sequence
- _____ joins _____ into new _____ strand using _____ as _____
  - New _____ to DNA template
- _____ binds to _____, _____ DNA
- RNA is synthesized by _____ with the nucleotides on the _____ of DNA
- Transcription continues until RNA Polymerase reaches the _____
- _____ and _____ are released, and the _____ re-forms

*Translation*

- "_____" the "language" of _____ into "language" of _____
- Codons: groups of _____ used to translate _____ acids into _____ acids
  - Each codon "codes" for an _____
  - Sequence of codon on _____ molecule determines sequence of _____
  - _____ is the genetic code

*The Genetic Code*

- Written as _____, _____
- Two types of codons
- Sense codons: code for _____
  - ____ codons for ____ amino acids
  - *Degeneracy of genetic code* - _____

- Nonsense codons: code for _____ in translation
  - Aka _____
- Translation starts with _____
  - Codes for _____
  - In Bacteria, translation starts with _____
- _____ carries _____ to _____
  - _____ carries _____ on one end ….
  - …. and has _____ at other end
  - Anticodon recognizes _____ on _____

*Process of translation*

- Components needed to begin translation come together
- Ribosome binds at _____
- _____ binds to _____
- Ribosome forms _____ between _____
- Ribosome moves along mRNA in _____ direction
- Translation continues until ribosome reaches _____
- Ribosome _____, mRNA, protein released

**Mutation**

- A _____ in the _____
- Mutations may be _____, _____, or _____
- _____: agent that causes _____
  - _____
- _____ mutations: occur in the _____ of a _____

*Types of mutations*

- Base substitution (point mutation): _____ is replaced by a _____
  - May cause change in _____, create a _____
- Frameshift mutation: one or a few _____ are _____ or _____ (not in _____ of _____)
  - Shifts "_____" of mRNA
  - Causes a change in _____
  - Almost always result in _____

*Outcomes of mutations*

- Silent mutation: mutations that have _____
  - Change in base, _____ change in _____
  - Due to _____ of genetic code
- Missense mutation: mutations that result in an _____ substitution in protein
- Nonsense mutation: mutation that introduces premature _____

*The Frequency of Mutation*

- Spontaneous mutations rate = _____ replicated base pairs or _____ replicated genes
- Mutagens increase to _____ per replicated gene

*Chemical mutagens*

- _____ with _____ to cause improper _____, deletions, _____
- Chemicals can convert bases to alter base pairing
- Nucleoside analogs – chemicals that are structurally similar to nitrogenous bases, but alter base pairing
    - Both cause base substitutions in base pairing
    - Eg, $HNO_2$, 2-aminopurine
- Chemicals can cause deletion or insertions into DNA
    - Result in frameshifts
    - Usually slip in between bases, bases lost or gained during replication

Radiation Mutagens

- Ionizing radiation –
    - Ionize molecules
    - Cause _____, leads to errors in DNA replication
- Nonionizing radiation -
    - Causes deletions of _____

**Genetic recombination**

- Exchange of _____ between _____ molecules
    - Contributes to _____
- In eukaryotes, genetic recombination happens regularly as part of _____
    - Recombination within one _____
- In prokaryotes, transfer of genes happens by:
    - _____ gene transfer
    - _____ gene transfer (recombination between _____)

*Horizontal Gene Transfer*

- _____ transfers part of its genome to _____ cell
- Recipient can _____ part of _____
    - Rest is _____
- Recipient cell that incorporates DNA is called _____
- _____ event, occurs between less than 1% of entire population

Three mechanisms of horizontal gene transfer:

- 
- 
- 

*Transformation*

- Transfer of _____
- "_____"_____ in environment
- Transformation - _____ of DNA
- Recombination – integration of _____ into _____
- Cell that recombines _____ is a _____ cell
- Frederick Griffith experiment, 1928, demonstrated that:
    - Transformation is possible

    - DNA is genetic material
- In nature, some bacteria release DNA into environment
    - After _____, cell _____
- Some bacteria can take up this DNA _____
    - Occurs naturally in some bacterial genera
- Competence: physiological state in which _____ can _____ via transformation
    - ie, *Haemophilus* can take up DNA only when _____

*Transduction*

- DNA transferred as a part of _____
- Two types of transduction
- _____ transduction – phage mediated transfer of _____ segments of DNA
- _____ transduction – phage mediated transfer of _____ segments of DNA
    - ie, some phages transfer only _____
- Process of generalized transduction -
    - Phage _____ the _____ bacterial cell. _____ DNA
    - Phage DNA and proteins are made and the bacterial chromosome is _____
    - Phage particle are assembled. Some phages mistakenly package _____
    - Phage carrying bacterial DNA (_____ phage) infect new host cell, the _____
    - _____ can occur, producing a _____ with a _____ different from both the _____ and _____ cells.

*Plasmids*

- Plasmids are _____ molecules of DNA
    - Small, about _____ of genome
    - Often carry genes that are _____ for survival
- _____ plasmids: carry genes for _____
    - _____

*Conjugation*

- _____ dependent DNA transfer
- Requires _____
- Conjugating cells must be of opposite "_____"
    - Donor cells must _____
    - Recipient cells must _____
    - Bacterial sex

*The F (Fertility Factor)*

- Conjugation requires _____ between donor (_____) and recipient (_____) cell
- _____ for conjugation on _____

*Hfr cells*

- Sometimes F factor _____
- $F^+$ cell becomes _____ cell

*Hfr Conjugation*

- Conjugation between Hfr and F- transfers _____ of donor _____
- Recipient is _____, but still _____

*Plasmids*

- _____ plasmids: carry genes for _____
- _____ plasmids: carry genes crucial for _____
    - 
    - 
    - 
- R factors: provide _____