Bacterial genetics

Gene

The unit of heredity, a segment of DNS that carries in its nucleotide sequence information for a specific biochemical or physiologic properties

Phenotype: the collective structural and physiological properties of a cell or an organism

genotype: the chemical Basis for variation in phenotype is change in genotype or alternation in the sequences of DNA within a gene or in the organization of a gene

Restriction enzymes: these enzymes cleave the DNA at specific sites, given rise to DNA **restriction fragments**

Plasmids: small genetics elements capable of independent replication in bacteria and yeasts

Polymerase chain reaction (PCR): amplification of specific regions of DNA

Organization of genes

The structure of DNA and RNA
Genetic information is stored as a sequence of bases on deoxyribonucleic acid DNA
Most of DNA are double strand, with complementary bases (A-T; G-C) paired by hydrogen bonding in the centers of the molecule

The complementary of the bases enables one strand (template strand) to provide information for copying or expression of information in the other strand (template strand) to provide the information in the other strand (coding strand)

The base pairs stacked within the center of the DNA double helix and they determine there genetic information
Each of four bases is bonded to phosphor-2-deoxyribose to for nucleotide

Kilo base (Kbp) the unit witch measures the length of DNA

Ribonucleic acid (RNA): most frequently occurs in single strand form

The base uracil (U) serve in RNA the hybridization function that thymine (T) serves in DNA so the complementary base that determine the structure of RNS are A-U and G-C

The most general function of RNA is communication of DNA gene sequences in the form of messenger RNA (mRNA) to ribosome the ribosome's which contain ribosome RNS (rRNNA) and proteins

Mutation and repair

The spontaneous development of mutation is a major factor in the evolution of bacteria mutations in nature occurs at low frequency, one the order of one mutation in every million cells for any one gene

Kinds of mutations

Mutations
Are hereditable changes in the structure of genes?
Wild-type-allele
The normal usually active gene
Mutant allele the inactive gene

Type of mutations
Replacements
Involve the substitution of one base of another
Micro-deletions and micro-insertions
Involve the removal and addition respectively of a single nucleotide
Insertion: involve the addition of many base pairs of nucleotides at a single site
Deletion
Remove contiguous segment of many pairs
Inversions
Change the direction of a segment of DNA by splicing each strand of the segment into the complementary strand
Duplication produces a redundant segment of DNA usually adjacent to the original segment

Mutation may classified according to there biological consequences

Resistant mutation: change in the susceptibility of a cell to antimicrobic or other toxic agent e.g. affects the structure of certain cell protein in such a way that the agent cannot enter the cell or cannot inactivate its normal target

Auxotrophic mutation affect the production of biosynthetic enzymes and results in nutritional requirement of the mutant cell for the amino acid, nucleotides, vitamin or other biosynthetic product it can no longer make for its self

Lethal mutation

Some mutation affects a gene whose product is essential for growth and cannot be by pass nutrition

Reversion of mutation

Reversion or back mutation is the conversion of a mutated gene back to its original wild –type allele

Back mutations rare because highly specie correction is needed

Repair of DNA damage

Many mutagenic agent directly alter the structure of DNA, and some are ubiquitous component of our environment (heat, sung light, acid, oxidant, and alkylating agents), it is therefore not surprising to learn that bacteria have multiple biochemical mechanism for repairing damaged DNA.

Genetic exchange
Bacterial evolution is speeded by exchange of genetic material
Process of genetic transfer
There are three process involves one to transfer DNA from adorner to a recipient
The molecule of DNA introduced into the recipient is called exogenote, and original chromosome is endogenote

Transformation: involves the release of DNA into the environment by the lyses of some cells, followed by the direct uptake of that DNA by recipient cells
Recombination with the bacterial chromosome take place to **transform** the cell, which then express the new genes.

transformation is detected by an alternation in the behavior and characteristics (phenotype) of the recipient bacteria .

Transduction the DNA is introduced into the recipient cell by non lethal virus (phage) that has grown on the donor cell
During phage replication , a piece of bacterial D NA becomes , by accident , enclosed within a phage particle in place of the normal phage DNA, when this particle infects a second bacterial recombined with the chromosome of the second bacterium. The bacterial gene transferred in this way are therefore expressed
Plasmid DNA can also transferred to the second bacterium by transduction . the donated plasmid can

then function and replicate independently without recombining with the chromosome of the bacterial cell

e.g. b-lactmase production ins staphylococcus aureus is plasmid mediated and the responsible plasmids transferred between staphylococcal strains by transduction

Conjugation involves the actual contact between donor and recipient cell during which DNA is transferred as a part of a plasmid (an autonomously replicating, extra chromosomal molecule of circular double –strand DNA)

Plasmids are the genetics elements most frequently transformed by conjugation

Bacterial DNA

The replication of bacterial DNA begins at one point and moves in both directions from there. The two old strands of DNA are separated and used as template to synthesize a new strand semi conservative replication. The structure

where the two strands are separated and the new synthesis is occurring is referred to as the replication fork

The genetic material in all bacteria is deoxy riboneuclic acid DNA
Bacterial plasmids are also DNA bacteriophages have DNA or RNA
The two essential function of genetic material are replication and expression
The expression involves transcription and transduction

Transcription
Involves the synthesis of RNA chain representing one strand of DNA (RNA is identical in the sequences with one strand on the DNA it is complementary to other strand which provides the template for it's synthesize

Transcription takes place the process of complementary base pairing catalyzed by the enzymes RNA polymerase

Initiation:
RNA polymerase must recognized and bind to the double DNA helix then local unwinding after separation of the two strand must occur to make the strand available for base pairing with ribonucleotide
Promoter the region on the DNA bind RNA polymerase which is AT-rich base pair

Elongation
Starts when few bases are incorporate into RNA chain forming RNA- DNA hybrid

To continue synthesis of RNA enzymes moves along the DNA unwinding the ds DNA as it moves to expose a new segment of DNA as SS,
As the enzymes moves the RNA that uses

Bacterial genetics
Bacteria have two types of DNA that contain their genes

- Chromosomal
- Exrachromosomal e.g. plasmid

The bacterial chromosome
Bacterial; are prokaryotes e.g. their chromosome is not contained within a nuclear membrane (unlike those of eukaryotes). The chromosome is:

Circular double strand DNA
Attached to the bacterial cell membrane

Genetic information is encoded in the sequence of purine and pyramiding base of the nucleotides which make up the DNA strand.

DNA replication is semi conservative e.g. each strand of DNA is conserved intact during replication and becomes one of the two strands of the new daughter molecules.
The main replicaze enzyme involves is DNA polemerase

Repair mechanism incorrect nucleotides sequences with nuclease replace them with the correct nucleotides and relegate the sequences

Restrictions enzymes are endonucleases and are types of defense mechanism found in many bacteria against incoming foreign nucleic acids. They cleave double stand DNA at specific sequences(usually six neucliotides) . The pattern of DNA fragments produces can be demonstrated by gel electrophoresis.