Genetic recombination and transposition produce new bacterial strains

There are three natural processes of genetic recombination in bacteria: ***transformation, transduction and conjugation***. These mechanisms of gene transfer occur separately from bacterial reproduction; and, in addition to mutation, are another major source of genetic variation in bacterial populations. Rem: Unidirectional!

Transformation = Process of gene transfer during which a bacterial cell assimilates foreign DNA from the surroundings.

- Some bacteria can take up naked DNA from the surroundings.
(Rem: Griffith's experiments with *Streptococcus pneumoniae*)
- Assimilated foreign DNA may be integrated into the bacterial chromosome by homologous recombination (just like crossing over).
- Progeny of the recipient bacterium will carry a new combination of genes.

Many bacteria have surface proteins that recognize and import naked DNA from closely related bacterial species.

Transduction = Gene transfer from one bacterium to another by a bacteriophage.

Generalized transduction = Transduction that occurs when random pieces of host cell DNA are packaged within a phage capsid during the lytic cycle of a phage.

- This process can transfer almost any host gene and little or no phage genes.
- When the phage particle infects a new host cell, the donor cell DNA can recombine with the recipient cell DNA.

Specialized transduction = Transduction that occurs when a prophage excises from the bacterial chromosome and carries with it some host genes adjacent to the excision site. AKA *restricted transduction*.

- Carried out only by temperate phages.
- Differs from general transduction in that specific host genes and most phage genes are packed into the same virion.
- Transduced bacterial genes are restricted to specific genes adjacent to the prophage insertion site. Whereas, in general transduction, host genes are randomly selected and almost any host gene can be transferred.

Conjugation = The direct transfer of genes between two cells that are temporarily joined by sex (?) pili.

The ability to form sex pili and to transfer DNA is conferred by genes in a plasmid called the F plasmid (F is for fertility).

Episomes = Genetic elements that can replicate either independently as free molecules in the cytoplasm or as integrated parts of the main bacterial chromosome.

Plasmid = A small double-stranded ring of DNA that carries extrachromosomal genes in some bacteria.

The F plasmid (Rem: F for fertility) has about 25 genes, most of which are involved in the production of sex pili.

- Bacterial cells that contain the F factor and can donate DNA ("male") are called F^+ cells.
- The F factor replicates in synchrony with chromosomal DNA, so the F^+ factor is inheritable; that is, division of an F^+ cell results in two F^+ daughter cells.
- Cells without the F factor are designated F^- ("female").

- The F factor replicates by ***rolling circle replication***. The 5' end of the copy peels off the circular plasmid and is transferred in linear form.

The F factor is an episome and occasionally inserts into the bacterial chromosome and can also revert to the plasmid state separating from the bacterial chromosome.

- Cells with integrated F factors are called *Hfr cells* (high frequency of recombination).

- Cells with an excised F factor AND attached chromosomal DNA are designated F' (F-prime) cells.

Transposons = DNA sequences or elements that can move from one chromosomal site to another.