## Lec2:microbial genetics Ass.Prof.Dr.Lamees A.Razzaq

## Conjugation

* A second mechanism by which genetic transfer takes place is conjugation.
* This mechanism requires the presence of a special plasmid called the **F plasmid.**
	+ The F plasmid, for example, facilities conjugation.
		- This can give a bacterium new genes that may help it survive in a changing environment.
		- An integrated plasmid is called an episome.
* Bacteria that have a F plasmid are referred to as F+ or male.
	+ Those that do not have an F plasmid are F- of female.
* The F plasmid consists of 25 genes that mostly code for production of sex pilli.
* A conjugation event occurs when the male cell extends his sex pili and one attaches to the female.
	+ This attached pilus is a temporary cytoplasmic bridge through which a replicating F plasmid is transferred from the male to the female.
	+ When transfer is complete, the result is two male cells.
* The F plasmid can behave as an episome.
	+ When the F+ plasmid is integrated within the bacterial chromosome, the cell is called an Hfr cell (high frequency of recombination cell).
* The Hfr cell still behaves as a F+ cell, transferring F genes to a F-cell, but now it can take some of the bacterial chromosome with it.
* Replication of the Hfr chromosome begins at a fixed point within the F episome and the chromosome is transferred to the female as it replicates.



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## Transduction

* Another method of genetic transfer and recombination is transduction.
* This method involves the transfer of DNA from one bacterium to another with the use of a bacteriophage (phage).
	+ A phage is a virus that infects bacteria.
	+ The phage T4 and the phage lambda, for example, both infect *E. coli*.
* Phages are obligatory intracellular parasites and must invade a host cell in order to reproduce.
	+ T4 multiplies by the lytic cycle which kills the host and lamba multiplies by the lysogenic cycle which does not cause the death of the host cell.
	+ In lysogeny, the phage DNA remains latent in the host until it breaks out in a lytic cycle.
* General Steps Of The Lytic Cycle:
	+ Attachment of T4 to receptors on *E. coli* cell wall.
	+ Penetration of the cell wall by tail core. Inject DNA into host.
	+ *E. coli* DNA is hydrolyzed. Phage DNA directs biosynthesis of viral parts using the host cell's machinery.
	+ The phages mature as the parts are assembled.
	+ Lyses of *E. coli* and release of the new phages.
* General Steps Of The Lysogenic Cycle:
	1. Phage attaches to *E. coli* and injects DNA.
	2. In the lysogenic cycle the circular phage DNA recombines with *E. coli* DNA and the phage DNA is now called prophage.
	3. *E. coli* undergoes cell division, copying prophage and passing to daughter.
		+ With more divisions there are more cells with the prophage.
	4. The prophage may exit the chromosome and start a lytic cycle at any time.

**Transduction can be generalized or specialized**.

* The Steps Of General Transduction:
	1. A phage attaches to cell wall of bacterium and injects DNA.
	2. The bacterial chromosome is broken down and biosynthesis of phage DNA and protein occurs.
	3. Sometimes bacterial DNA can be packaged into the virus instead of phage DNA.
		+ This phage is defective (can't destroy another host cell) because it does not carry its own genetic material.
	4. The cell lyses, releasing viruses.
	5. The phage carrying bacterial DNA infects another cell.
	6. Crossing over between donor and recipient DNA can occur producing a recombinant cell.
* In generalized transduction, any bacterial genes can be transferred because the host's chromosome is broken down into fragments.
	1. Whatever piece of bacterial DNA happens to get packaged within the phage is the genetic material that will be transferred between cells.





* In specialized transduction, on the other hand, only certain bacterial genes can be transferred.
	1. Specialized transduction requires a phage that uses the lysogenic cycle for reproduction.
	2. The Steps In Specialized Transduction:
		+ Remember that in the lysogenic cycle, phage DNA can exist as a prophage integrated in the bacterial chromosome)
		+ Occasionally when the prophage exits it can take adjacent bacterial genes with it.
		+ The phage DNA directs synthesis of new phages.
			- The phage particles carry phage DNA and bacterial DNA.
		+ The cell lyses, releasing the phages.
		+ A phage carrying bacterial DNA infects another cell.
		+ The joined phage and bacterial DNA circularize.
		+ Along with the prophage, bacterial DNA integrates with the recipient chromosome by a cross over event.
			- This forms a recombinant cell.





