DNA replication – When does it occur? – during cell divisition/s phase.

Replicons for DNA replication

Replicon is the unit of DNA in which individual acts of replication takes place. It contains an origin of replication and control units to regulate the process. Its number may vary in a genome from one in prokaryotes and 500 in yeast to several thousands in animals and plants. In *E. coli* there is a single replicon with the origin, identified as a genetic locus *oriC* (245 bp). These are A:T rich sequences, a feature which is related to unwinding of DNA to initiate replication.

Table 26.4. **Prokaryotic and eukaryotic replicons.**

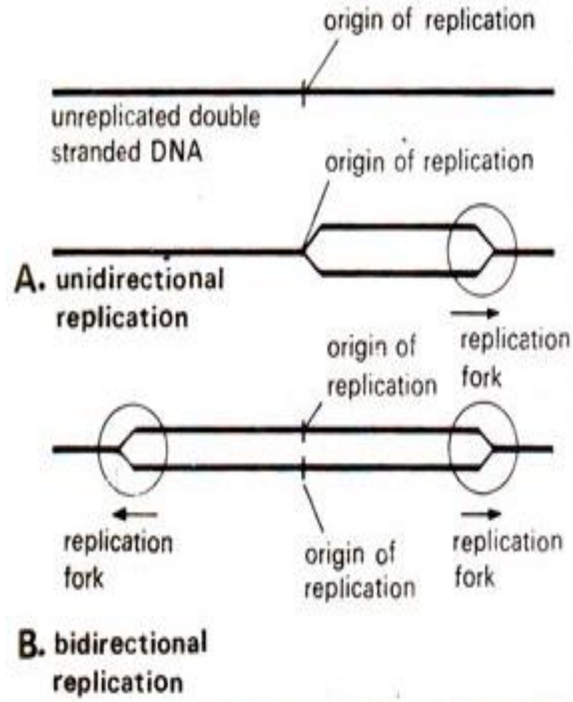
Organism	No. of replicons	Average length (kb)	Fork movement (bp/min)
Bacteria (*E. coli*)	1	4200	50,000
Yeast (*S. cerevisiae*)	500	40	3,600
Fruitfly (*D. melanogaster*)	3500	40	2,600
Toad (*X. laevis*)	15000	200	500
Mouse (*M. musculus*)	25000	150	2,200
Bean (*Vicia faba*)	35000	300	not known

In a eukaryotic genome, there are many replicons, an individual replicon being small and the rate of replication being much slower. Not all replicons start replication at the same time, but the initiation of replication at different replicons takes place in a regulated manner.

Replication fork : The point at which strands of the parental DNA are separated and replication is taking place (new nucleotides are being added) is called replication fork.

Direction of replication :

DNA replication can be **unidirectional** or **bidirectional,** depending upon whether the replication from the point of origin proceeds only in one direction or proceeds in both the directions. A replication eye may appear in both the situations, unless the replication starts from one of the two ends of a linear DNA molecule. However, in **unidirectional replication,** one of the two ends of the replication eye will be **stationary** and the other end will move with replication (only one replication fork). On the other hand, in **bidirectional replication,** none of the two ends will be stationary and both will be moving (two replication fork moving in opposite direction). An example of unidirectional replication is the replication of **mitochondrial DNA (mtDNA)** in vertebrates. (Two third DNA of mitochondria replicates unidirectionally)



Semi-discontinuous DNA replication:

All **DNA polymerases** synthesize DNA in 5'→3' direction. Since the two strands of DNA have opposite polarities, DNA synthesis can not proceed on both strands, utilizing same enzyme, unless the synthesis proceeds in pieces. Such pieces called Okazaki **pieces** (after the name of discoverer) have actually been observed and it is established that DNA synthesis is discontinuous on one of the two strands and the segments are later joined by the enzyme **ligase.** DNA synthesis is continuous on one strand and discontinuous on the other strand. DNA strand synthesized continuously (on the 3’ – 5’ template strand) is called the **leading strand.** Other strand which is synthesized discontinuously (on the 5’ – 3’ template strand) in a direction opposite to that of the leading strand is called the **lagging strand.** Synthesis takes place in segments discontinuously (Okazaki fragments) which are then fused to form an intact lagging strand. Length of the okazaki fragments is between 1000-2000 nucleotides in prokaryotes and 150-200 nucleotides in eukaryotes. This behaviour where the leading strand is synthesized continuously and the lagging strand is synthesized discontinuously is called semi-discontinuous replication.

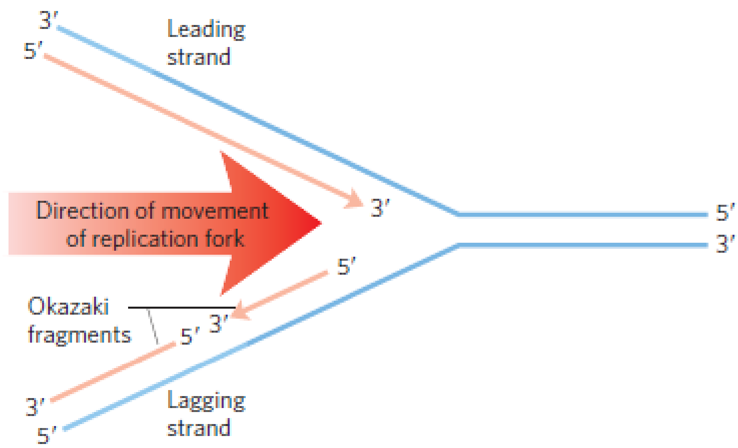


FIGURE 25–4 Defining DNA strands at the replication fork. A new DNA strand (light red) is always synthesized in the 5′→3′ direction. The template is read in the opposite direction, 3′→5′. The leading strand is continuously synthesized in the direction taken by the replication fork. The other strand, the lagging strand, is synthesized discontinuously in short pieces (Okazaki fragments) in a direction opposite to that in which the replication fork moves. The Okazaki fragments are spliced together by DNA ligase. In bacteria, Okazaki fragments are ~1,000 to 2,000 nucleotides long. In eukaryotic cells, they are 150 to 200 nucleotides long.