

## Highlights DNA Replication (continued)

1. Replication of linear eukaryotic chromosomes is more complex than replicating the circles of prokaryotic cells. During each round of eukaryotic DNA replication, a small portion of the DNA at the end of the chromosome (known as a telomere) is lost. Telomeres have thousands of copies of the same short nucleotide sequence. Telomere length may be relative the cellular lifespan.
2. Telomerases are enzymes that make telomeres and they are active in fetal cells. They serve to elongate the ends of linear chromosomal DNAs, adding thousands of repeats of a short sequence (junk DNA). This "junk DNA" is called a telomere. At each round of eukaryotic DNA replication, a short stretch at the end of the DNA is lost, shortening the telomere. The longer a telomere is, the more times a cell can divide before it starts losing important DNA sequences.
3. Tumor cells are another cell type that has an active telomerase. This probably is a factor that enables them to be "immortal".
4. Telomerase acts as a reverse transcriptase, using an RNA primer that it carries with it to copy and make the repetitive sequences of the telomere.
5. Eukaryotic cells tightly control the process that leads to their division. The cycle is called the cell cycle and the protein p53 plays an important role. If p53 detects that replication has not completed properly, it stimulates production of repair proteins that try to fix the damage. If the damage is fixed, the cell cycle continues and the cell ultimately divides. If the damage cannot be fixed, p53 stimulates the cell to commit suicide - a phenomenon called apoptosis.

## Highlights Transcription

1. Transcription is the making of RNA using DNA as a template. Transcription requires an RNA polymerase, a DNA template and 4 ribonucleoside triphosphates (ATP, GTP, UTP, and CTP). Prokaryotic cells have only a single RNA polymerase. Transcription occurs in the 5' to 3' direction. RNA polymerases differ from DNA polymerases in the RNA polymerases do NOT require a primer.
2. Transcription requires DNA strands to be opened to allow the RNA polymerase to enter and begin making RNA. Transcription starts near special DNA sequences called promoters.
3. A factor known as sigma associates with the RNA polymerase in *E. coli* and helps it to recognize and bind to the promoter. A promoter is a sequence in DNA that is recognized by the RNA Polymerase-Sigma complex. (Note that sigma factor binds to BOTH the RNA Polymerase and to the promoter sequence in the DNA. Note also that sigma factor is a PROTEIN). Genes that are to be transcribed have a promoter close by to facilitate RNA Polymerase binding to begin transcription.
4. Promoters in *E. coli* have two common features. The first is a sequence usually located about 10 base pairs "upstream" of the transcription start site (the transcription start site is the location where the first base of RNA starts). This sequence is known as the "-10" sequence or the Pribnow box', which is so-named because the most common version of it (known as a consensus sequence) has the sequence 5'-TATAAT-3'. The second common feature of *E. coli* promoters is located about 35 base pairs upstream of the transcription start site. Eukaryotic promoters also frequently have a TATA box, but in a slightly different position.

5. Transcription occurs in three phases - initiation, elongation, and termination. Binding of RNA Polymerase and sigma is the first step in transcription (initiation). After polymerization starts, sigma factor leaves the RNA polymerase and the elongation process continues.

6. Termination of transcription in *E. coli* occurs by several mechanisms. One I discussed in class is factor independent transcription termination, which occurs as a result of a hairpin loop forming in the sequence of an RNA. When it forms, it "lifts" the RNA polymerase off the DNA and everything falls apart and transcription stops at that point.

7. Factor dependent termination and is caused by a protein called rho. Rho works by binding to the 5' end of the RNA and sliding up the RNA faster than the RNA Polymerase makes RNA. When rho catches the RNA polymerase, it causes the RNA polymerase to dissociate (come off of) the DNA and release the RNA.