Destruction by DNA

We know from the lecture that DNA helps us to explore our evolutionary history. We can trace the similarity of DNA from two species to find a phylogenetic ancestor. However, is there ever a point when DNA is not beneficial, but harmful to us? This occurs when a DNA sequence is disturbed or altered, which results in *apoptosis*, automatic cell death, in our body. How can DNA sequences be altered inside our body? There are three types of mutation that are responsible for this incidence of apoptosis: substitution, deletion, and methylation.

Substitution – DNA sequences are formed by four different nucleotides. During the process of DNA replication, it is possible that the replication mechanism permits an incorrect nucleotide to be included within a DNA sequence. The newly replicated DNA may not function properly due to this incorrect substitution within the sequence. Fortunately, in this scenario, only one nucleotide has been incorrectly inserted into the sequence. The consequence of this one mutation may not be as disastrous as other forms of mutations, where several nucleotides are miscoded. The single incorrect sequence may be repaired by other self-repairing mechanisms.

Deletion – When a nucleotide is deleted from a DNA sequence, the consequence may be very serious. Protein synthesis is performed by RNA. RNA interprets the DNA sequence, 3 nucleotides at a time, to synthesize a specific protein. If deletion of a nucleotide within the DNA sequence occurs, the interpretation of the DNA sequence by RNA will be changed completely. It can be illustrated by the following example (Uracil in RNA is the analog of thymine in DNA):

Original Sequence: UCG UGC AAU CGU AGC G… (Ser – Cys – Asn – Arg – Ser)
Altered Sequence: UCG UGA AUC GUA GCG… (Ser – STOP)

RNA, interpreting the second pair of altered nucleotides (where cytosine has been deleted), reads a signal to stop protein synthesis. The abnormal production of proteins would induce malfunctions of body systems that may have a great impact on our health.

Methylation – DNA methyltransferases adds methyl groups to cytosine within a DNA sequence. The methyl group projects to the outside of the DNA double-helix, altering the common and recognizable DNA structure. Because the new altered DNA structure is different from an ordinary double-helix, the DNA-binding protein may not recognize the nucleotide, and cause unexpected interaction. The methylation results in gene silencing, which causes a loss in gene function.