Weekly Homework 5

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1 About telomeres

Telomeres are a repeated sequence on nucleotides and one the main chromosomes' components. They are placed at the extremities of each one's chromosomes and their main purpose is to help during the DNA replication process, since the enzyme in charge of it is not able to fully support it. Therefor, after every round of DNA replication a small part of each chromosome is left behind, making them smaller and smaller during time. It is well-known that all of us start our lives with the same chromosomes length, which is around 11 kilo-bases for humans, but they shorten differently from one person to another. Because of that, it is believed that chromosomes are strongly connected with cellular aging and may also influence our appearance. Telomeres can be found in both eukaryotic organisms and prokaryotic organisms, but they encode different nucleotides sequences from one category to another.
Moving on, I'll discuss a couple of aspects: the current interest in the world for telomeres lengthening throughout different methods, and how a stressful environment can accelerate telomeres' shortening, but also how some recent results emphasize how men's telomeres have a faster decrease rate than women's telomeres.
Let's start with the first part, which is telomeres lengthening. A study from 1984, awarded with a Novel Prize only in 2009, which was presented in detail in a TEDxTalk by Elizabeth Blackburn focuses its research on a ordinary and apparently uninteresting organism called pond scum. Elizabeth together with her collaborators discovered thanks to this organism, pond scum, a new enzyme in telomerase. By simply looking at pond scum's telomeres length,

they've noticed that they alternate their length. From one day to another, they could either lengthen or shorten. Starting from this point, she raises the question about us human using telomerase that we do have in cells that need to frequently divide for lenghtening out telomeres. At that point, it looked like this procedure could do us humans more harm that good, since it could trigger different types of cancer. Anyway, another interesting article that I've found comes from Stanford University. In 2015, they release a method for increasing one's telomeres' length by 10% by using an active component from STEM cells called TERT. Anyway, this topic is active even in our days, an the most recent breakthrough that I've found was in October 2019, when some scientist managed to actually increase mice's lifespan by extending their telomeres in all of their cells.

The second part, stresses about how an inappropriate environment can have disastrous consequences. Also in Elizabeth's TedxTalk, she presents an experiment which affects several women who's children were having severe medical conditions. After some observation time, it was noticed that some women had telomeres much shorter that other. When asked about how they treat their child's condition, some women saw it as a challenge, while other were panicking about it. Later on, researchers draw a correlation between telomeres size, and how stressed those women were. Furthermore, even in our days there are several articles which promote as ways of slowing down telomeres shortening either meditation, having a work-life balance and a healthy diet.

2 Supplementary videos

2.1 CRISPR-CAS9

The first video that I've seen focuses its attention on CRISPR and CAS9. The video starts by presenting a short history about gene editing since the first experiments where plants were radiated just of out sheer curiosity in order to get random mutations, followed by modifying vegetables and fruits so that they may stay for a longer period of time of supermarket's shelves and ending with the first case where infertility was treated by inserting genetic information from a third person (a second mother), thus creating a baby with genetic information

from 3 humans. Moving on, CRISPR is described as an archive where each organism stores genetic information about the viruses it successfully beaten. Thanks to this CRISPR, we keep in our genetic code a DNA copy of all the previous viruses that infected us and when a new one comes, CAS9 (which is a protein) checks if we've encountered the same virus before. In case it finds that virus' genetic information in our so-called database/archive, it cuts it out of our system. Moving on, it is shown how CRISPR can actually be programmable, so in the near future a lot of virus related diseases such as HIV and herpes may be completely eradicated from our system by simply introducing in our system CRISPR information which has that virus already encoded inside.

2.2 SANGER sequencing

The second video talks about SANGER sequencing and its main phases of development. It is described as a sequencing based on an in vitro DNA synthesis, which follows the principle of DNA replication. The first step in finding out the order of one's nucleotides in a DNA section is by amplifying its size, followed by heating it up so that the two DNA strands can separate. After that, a primer is attached to one end so that it will initiate the DNA synthesis. All of that is equally distributed into four containers, it is added DNA polymerase and one special type of each nucleotide (called ddNTP) in each container. The polymerase helps chaining the nucleotides after the special nucleotide is attached to its pair, thus forming different length segments. In the end, the gel electrophoresis technique is used for identyfing each nucleotide.

2.3 DNA

The DNA encodes each one of us' genetic information and is unique among all of us. It is a double strand structure, which is composed out of two polynucleotides. Of course, each of those polynucleotides is composed out of numerous other nucleotides (each one of them being one out of the four purine bases: adenine, guanine, cytosine and thymine).

2.4 DNA replication

The fourth video explains the concept of DNA replication. This process starts by unzipping the two strands with the help of enzymes. Moving on, the RNA primer comes in in order to pair with a newly freed DNA nucleotide of complementary type, which are later replaced by another enzyme with actual DNA nucleotides. Thus, now there are formed two other nucleotides strands bound by the two former nucleotides strands.

2.5 Gel electrophoresis

The concept of gel electrophoresis is mostly used for separating DNA fragments and molecules based on their size. One well known use-case is for DNA sequencing. The actual machine for doing this procedure uses a large bowl filled with a thin layer of gel, at which ends are attached electrodes. With samples being placed at one end, electric current is applied making those charged molecules move towards the electrode with opposite charge from their own. Thus, it was observed that some molecules move faster than other, decoding their type in this manner.