Optimizing Biological and Architectural Designs

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Living Architecture Research Project Report

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Rule-to-build-by:

To achieve the best design for biological and architectural machines, it is best to continuously tinker with the building plans for optimal results.(Morris and Staudinger/2010)

What:

Evolution and adaptation of all living organisms upholds the principle to constantly change the building structure. Living organsims all originates from the genes of DNA which reflect into the transcription of RNA which reflect into translation of proteins which reflect the changes in the organisms and how they are built.

The twin towers in New York were modified twice since the original construction. The buildings, just like cells, need to adapt to outside environment if the building plans on staying upright.

How:

DNA is a set of nucleotides (T,A,C,G) that has a phosphate backbone. In the series of nucleotides, T pairs up with nucleotide A, and C pairs up with G. A set of certain nucleotides in a specific order creates a gene. Different genes result in different characteristics of what is shown in the organism. Genes are transcribed into RNA and then translated into proteins. This action is referred to as the "central dogma" in biology.
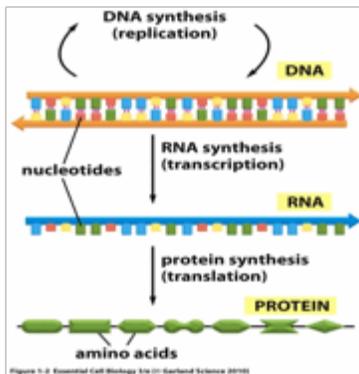

Figure 1 shows the "central dogma" of biology. At the top of figure 1 is a DNA strand. The arrows show it can replicate itself for can undergo RNA synthesis/ translation. RNA has a corresponding set of nucleotides to opposite match the nucleotides in the DNA strand. RNA can undergo protein synthesis/translation, where it is made into a Protein. The protein shows different amino acids made from the DNA.(Alberts/2010)

The transcription step occurs in the DNA, while the translation step occurs in the cytosol. DNA can also undergo replication. When a cell divides, both cells have copies of the DNA. DNA has a series of nucleotides in a certain order that are known as promoter regions. Proteins bind to promoter regions, including a protein called RNA polymerase. These proteins are called the transcription initiation site. When all the necessary proteins bind to the promoter region, an enhancer region of the DNA (another section of DNA with a sequence of nucleotides with a corresponding protein)

will loop around and start the process of transcription. RNA polymerase "unzips" the DNA and transcribes one side of the DNA nucleotides with an RNA strand.
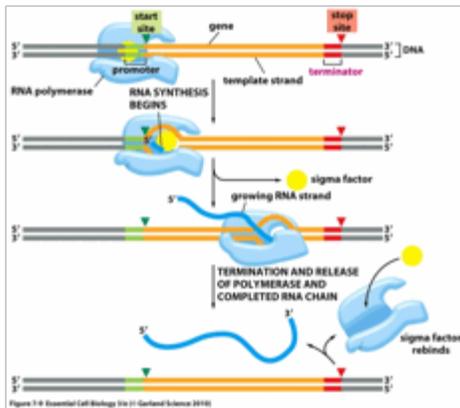

Figure 2 shows how RNA polymerase transcribes a region of DNA into a strand of RNA. The start site is known as the promoter region where RNA polymerase and other proteins bind to. The stop site is the deactivator region where RNA polymerase disassociates itself from the DNA strand.(Alberts/2010)

The RNA strand has two differences from the DNA strand. The first difference in the RNA nucleotide oppositely corresponds to the DNA sequence pairing. The second difference in the RNA sequence is that every T that would appear in the RNA sequence is replaced with a U. The RNA strand travels out of the nucleus and eventually reacts with a ribosome to become translated into a protein. Ribosomes translate the RNA by reading the codons on the RNA. Codons are sections of three RNA nucleotides at a time. Each codon relates to a specific amino acid. Many codons can relate to one amino acid, however, there is only one start codon that corresponds to one amino acid, methionine. The ribosome "reads" the strand of RNA until the start codon appears, which is AUG. Once the start codon is translated, then the ribosome translates the RNA into the amino acids by the set of codons. The ribosome continues to do this until a "stop" codon appears which ends the process of translation for that particular protein. The protein that was made might have a signal sequence to which it will travel off to. Each protein has its own specific function to carry out.(Alberts/2010)

When mutations occur in the DNA, this is when genetic differences occur. DNA mutation can occur in the self-replicating step of the process or in the transcription of DNA into RNA.
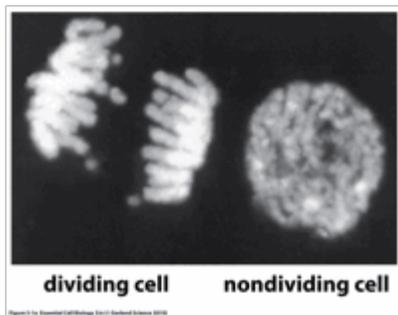

Figure 3 shows a dividing cell and a nondividing cell. In the dividing cell, the DNA made copies of itself so that both new cells have DNA. During the process of replication is when the probability of mutations occurs.(Alberts/2010)

Even one mutation that affects a single nucleotide affects the whole sequence of transcription and translation. The corresponding RNA would change and how the ribosome would translate the RNA might change producing a different protein from what it should be normally. Some mutations could be advantageous, while others could cause disease.(Alberts/2010) The human genome project first came out in 2003. Since then, it has been easily available for biologists to "fool around with a DNA sequence. To find out what some mutations do, biologists have in fact forced mutations upon DNA to see the results.(Beris/2010)

The twin towers suffered through three external causes that pushed the buildings to destruction. In 1975, a fire broke out in one of the buildings and in 1993, the basement of one of the buildings were bombed. After both events, the

architects had to design a new way to support the towers to make sure they do not fall down after the occurrences. The new support worked because the buildings did not fall down. The original architect who built the twin towers built very stable structures because the buildings were able to withstand bombings and a fire without collapsing. (Wikipedia/2010)

Why:

When biologist introduced the Human Genome Project, they made it possible by unlocking close to all of the human's genes. By unlocking most of the genes, it will be possible for biologists to tinker with different DNA genes by changing nucleotides.(Beris/2010) When this is done, the biologists need follow the gene sequence to the corresponding amino acid and figure out what proteins will come out of the altered strand. A good mutation will enable adaptation and ultimately help the body. If biologists figure out what proteins cause genetic diseases and can trace it back to the DNA strand, it will be possible to change the nucleotides and eliminate disease. From an evolutionary standpoint, it will be possible to look up the DNA of a fetus and find out what diseases, if any, the baby will have. If the baby does have a disease, it will then be possible to change the DNA to make sure the disease will not affect the baby. By eliminating genetic diseases, then the life-span of human would increase.

It was said that all life first started with RNA.(Alberts/2010) If biologists are able to change the RNA to whatever, they please, controlling what proteins are made, how many proteins are made; essentially it would be possible to control how we want our cells to act and the traits of organisms. If a person has genes for brown eyes, it would be possible to alter that gene to make the organisms eye's any color of our choice. Although this is not possible at this moment, the science involving the area of the DNA has evolved greatly since the Human Genome Project was launched and made available to the public. To put this in perspective, DNA was discovered just a little over sixty years ago. Now the entire human genome is online and anybody can look up the genes. (Beris/2010)

There are some limitations concerning the area of DNA science. Biologists are not able to just make up their entire own DNA sequence. A template of the existing DNA in the human must be used. Single nucleotides must be changed, not the whole genome. Biologists have yet been able to choose what specific nucleotide they want to change; they can just alter the gene for now. (Beris/2010) If biologists mess up with the mutation, this could have a drastic outcome for the organism. Biologists will not be able to just "start over from scratch", improvements need to be made changing the desired mutation. There are different types of mutation in the RNA. A mutation in the RNA might not even change the corresponding amino acid and this is known as a silent mutation. The mutations that do change the amino acid or change the reading patterns of the codons are the mutations that matter most and could have a huge impact on our future lives.(Alberts/2010)

Architects are able to greatly mess up and start from scratch. If the building fails, the architect can make an entirely new model and build that one. The twin towers fell down from terrorist attacks. The building could not overcome a direct blow and fell down.

Figure 4 shows the two towers after the terrorist attacks. This is before the buildings fall down. The two towers were very stable because the buildings did not fall down right away.(Schwittek/2001)

Although the twin towers have yet to be rebuilt, architects can make a completely new design and build new twin towers making them even bigger if they wanted to. Architects learn from mistakes. They learn what went wrong with their original idea and fix the problem. Architects learning to improve the buildings are advantageous to us because if buildings fell, such as the twin towers, many people will be killed during the collapse of the building. (Wikpedia/2010) Biologists do not have the advantage of an architect. Biologists have to be more careful of their work

to make sure their DNA mutation does not have a negative influence on society.

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