DNA - The Double Helix

Recall that the nucleus is a small spherical, dense body in a cell. It is often called the "control center" because it controls all the activities of the cell including cell reproduction, and heredity. How does it do this. The nucleus controls these activites by the chromosomes. Chromosomes are microscopic, threadlike strands composed of the chemical DNA (short for deoxyribonucleic acid). In simple terms, DNA controls the production of proteins within the cell. These proteins in turn, form the structural units of cells and control all chemical processes within the cell.

Chromosomes are composed of genes. A gene is a segment of DNA that codes for a particular protein which in turn codes for a trait. Hence you hear it commonly referred to as the gene for baldness or the gene for blue eyes. Meanwhile, DNA is the chemical that genes and chromosomes are made of. It stands for deoxyribonucleic acid. DNA is called a nucleic acid because it was first found in the nucleus. We now know that DNA is also found in organelles, the mitochrondria and chloroplasts.

In 1953, James Watson and Francis Crick established the structure of DNA. The structure is a double helix **(color the title black)**, which is like a twisted ladder. It is interesting to note that the twist in all organisms is to the right and not to the left although it is not known why. The sides of the ladder are made of alternating sugar and phosphate molecules. The sugar is deoxyribose. **Color the phosphate title and all the phosphates pink. Color the deoxyribose title blue and all the deoxyriboses blue.**

The rungs of the ladder are pairs of 4 types of nitrogen bases. Two of the bases are purines. The purines are adenine and guanine. The pyrimidines are thymine and cytosine. The bases are known by their coded letters A, G, T, C. These bases always bond in a certain way. Adenine will only bond to thymine. Guanine will only bond with cytosine. **Color the title adenine and all the adenines orange. Color the title thymine and all the thymines yellow. Color the title cytosine and all the cytosines red. Color the title guanine and all the guanines green.** The bases are held together by a type of chemical bond called the hydrogen bond. The pictures depict this with a "H". **Color the title and all hydrogen bonds grey**. Note that that the bases attach to the sides of the ladder at the sugars and not the phosphate.

So, now, we know the nucleus controls the cell's activities through the chemical DNA, but how? It is the sequence of bases that detmine which protein is to be made. The sequence is like a code that we can now interpret. The sequence determines which proteins are made and the proteins determine which activities will be performed. And that is how the nucleus is the control center of the cell. The only problem is that the DNA is too big to go through the nuclear pores. So a chemical is used to to read the DNA in the nucleus. That chemical is messenger RNA. The messenger RNA (mRNA) is small enough to go through the nucleur pores. It takes the "message" of the DNA to the ribosomes and "tells them" what proteins are to be made.

Every cell in your body has the same "blueprint" or the same DNA. Yet, how can a heart be so different from a brain if all the cells contain the same instructions. Although much work remains in genetics, it has become apparent that a cell has the ability to turn off most genes and only work with the genes necessary to do a job. We also know that a lot of DNA apparently is nonsense and codes for nothing. These regions of DNA that do not code for proteins are called introns, or sometimes "junk DNA".

Name _____

1. Why is the nucleus called the "control center" of the cell?

2. Describe a chromosome.

3. What is a gene?

4. Where in the cell are chromosomes located?

5. DNA can be found in what organelles?

6. What two scientists established the structure of DNA?

7. What is the shape of DNA?

8. What are the sides of the DNA ladder made of?

9. What are the 4 bases that make up the rungs of the DNA ladder?

10. What sugar is found in DNA?

11. How do the bases bond together? A bonds with _____ G bonds with _____

12. What is the role of messenger RNA in the production of protein?

13. Why is RNA necessary to act as a messenger? Why can't the code be taken directly from the DNA?

14. Proteins are made where in the cell?

15. How do some cells become brain cells and others become skin cells, when the DNA in ALL the cells is exactly the same. In other words, if the instructions are exactly the same, how does one cell become a brain cell and another a skin cell?

16. Why is DNA called the "Blueprint of Life"?