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The Blueprint of Life

In previous labs, you learned that your traits are controlled by the genes on your chromosomes. Now it is time to examine those chromosomes a little more closely and see what they are made of.

The chromosomes in the nuclei of every living things cells are made of **deoxyribonucleic acid** (**DNA**), a long complex molecule. A section of this DNA on a chromosome is called a gene and will control an individual trait. But how?

Before modern technology, scientists could only hypothesize about the actual structure of DNA and the first two scientists to do that were **James Watson** and **Francis Crick** in 1953 when they presented the first 3D model of the DNA molecule. Their discovery relied heavily on the work of **Rosalind Franklin**, who is given credit for first discovering its shape using x-ray crystallography. Since its discovery and the release of the first model identifying its unique structure, research has focused on understanding how DNA is considered the blueprint of life and can lead to the development of cures for many diseases and the betterment of life for many species.

Focus Question

What is the structure and role of DNA?

DNA Structure

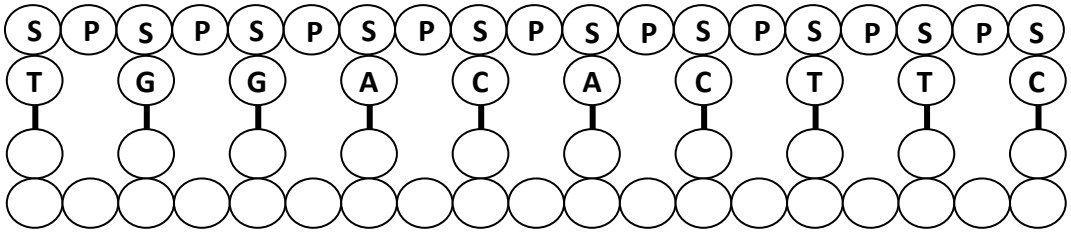
DNA is a twisted ladder-like structure known as a **double helix** that has two sides with rungs between them. Each side of the ladder is made up of alternating **deoxyribose sugar** and **phosphat**e molecules. There are four nitrogenous bases, **adenine, guanine, thymine** and **cytosine** that pair up to make up each "rung" of the ladder. Adenine (A) is always paired with thymine (T). Guanine (G) is always paired with cytosine (C). Nitrogenous bases are held together by a **hydrogen bond**.

Practice

Observe each of the following pairs of nitrogenous bases. Circle each of the pairs which DO follow the base pair rules.

G – C	T – A	G – G
C – A	A – G	G – T
C – C	C – G	A – T

DNA Model—pictured is one side of a DNA molecule…how would you complete the other half?



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The sequence of nitrogenous bases in DNA is a "code" that contains the instructions for making the chemicals needed to carry out the important functions that keep organisms alive. These chemicals also help determine an organism's traits. The sugar and phosphate sides of the DNA molecule are always the same, but the sequence of the nitrogenous bases changes in the center depending on organism/chromosome/gene. Scientists can interpret this "code" and will only write the sequence in groups of three as they are trying to figure out the chemical code of the DNA molecule they are analyzing. Here is an example of how it might be written:

Side 1:	T A A	A G T	A C C
Side 2:	A T T	T C A	T G G

Now you try…how would your sequence be written from above? Check with a friend after you are done to see if you are correct.

The chemicals mentioned above are called **proteins**. The DNA provides the "code" to make these proteins, and each protein is responsible for making and building cells. Cells then build tissues which make organs. Organs combine to create organ systems to perform all the life processes, and voila…you can now see how DNA is the blueprint for life! For example, your skin produces a protein called melanin to protect you from UV exposure, and muscle produces actin and myosin to help in contraction. Every cell produces some protein thus letting it know what kind of cell it is ultimately going to be. Proteins are unique to the cells they form inside of.

DNA provides the blueprint that gives the cell an exact plan for the type of proteins to make which in essence determine its place in the body/organism. The sequence of the nitrogenous bases (A,T,C, and G) along a section of DNA forms a "code" to make each protein. A **gene** is a section of the DNA that codes for one protein, and the average gene can have hundreds or thousands of individual nitrogenous base pairs.

Summary

1) A "recipe" for making a protein and located on a chromosome is called what?

2) Find two additional examples of proteins and the types of cells they are found in.
   a)

   b)

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3) How is the DNA in your body similar to the DNA found in all living things? How is it different?

Application

1) Draw all the following and **show how they are related**: DNA, chromosome, nucleus, gene, cell, protein, trait. Search in your textbook for help if you can't do from memory.

2) Describe the structure of DNA.

3) Describe the role of DNA (you may not only say "blueprint of life").

*Online Challenge--You have more than two hundred different kinds of cells in your body. Each contains the same complete set of DNA (chromosomes), but the cells look different and do different jobs. Explain how this is possible that your cells can be so different from each other, even though the DNA is identical in every cell.