DNA - The Double Helix

DIRECTIONS: Read the background information. Then color all of the boxed diagrams according to the instructions and answer the questions that follow.

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 activities by the chromosomes. Chromosomes are microscopic, threadlike strands composed of the DNA (short for **d**eoxyribo**n**ucleic **a**cid.) In simple terms, DNA controls the production of proteins within the cell. Some of these proteins form cell structures and other proteins called enzymes 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 mitochondria and chloroplasts, though it is the DNA in the nucleus that actually controls the cell's workings.

The structure of DNA is a double helix, which is like a twisted ladder. The sides or "uprights" of the ladder are made of alternating sugar and phosphate molecules. The sugar is deoxyribose. Color all the phosphates pink (one is labeled with a "p"). Color all the deoxyribose blue (one is labeled with a "D").

The rungs of the ladder (the parts you would climb on) are pairs of 4 types of nitrogen bases. Two of the bases are purines - 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. ("A goes with T and G goes with C") This is known as the Base-Pair Rule. The bases can occur in any order along a strand of DNA. The order of these bases is the code that contains the instructions. For instance ATGCACATA would code for a different gene than AATTACGGA. A strand of DNA contains millions of bases. (For simplicity, the image only contains a few.) Note that the bases attach to the sides of the ladder at the sugars and not the phosphate.

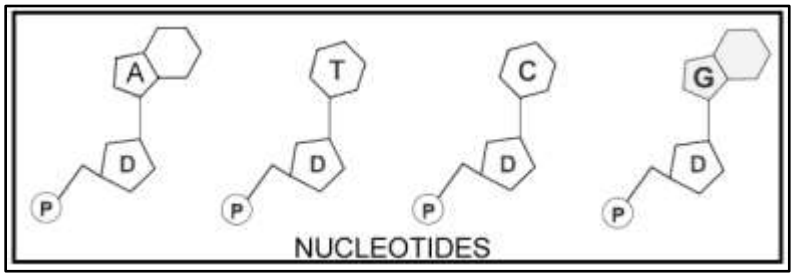
*****Use this color scheme when coloring the full DNA molecule on the back*****

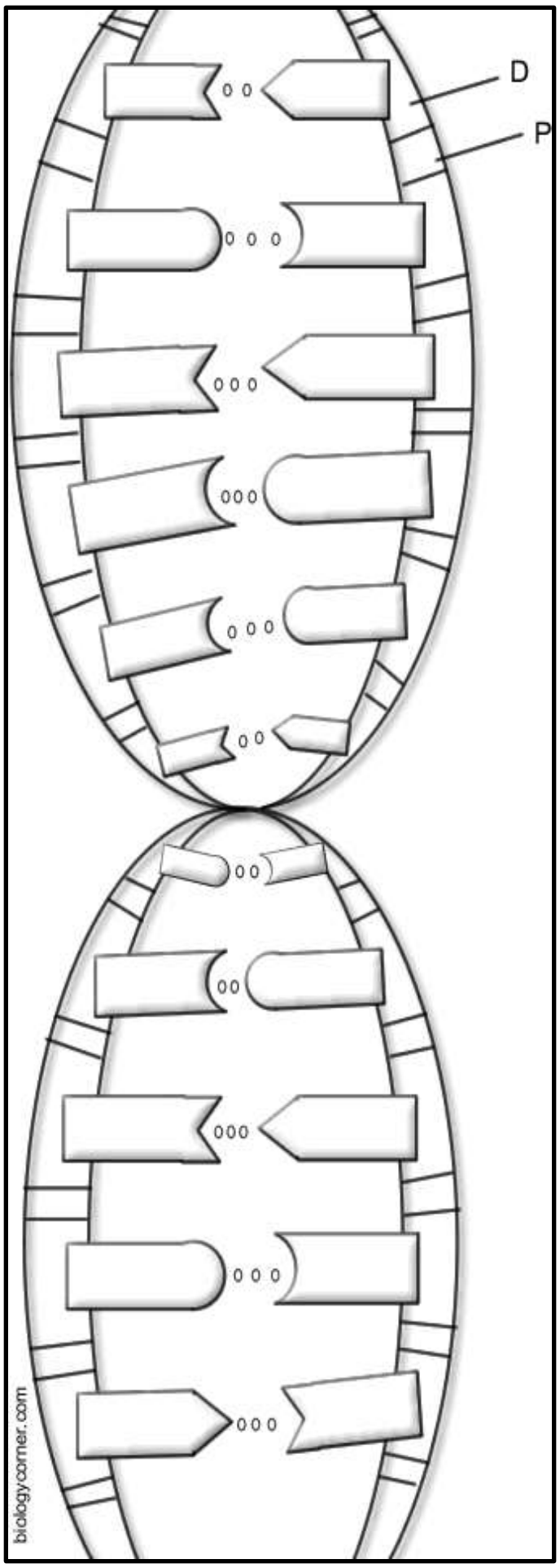
Color the thymines orange. Color the adenines green.

Color the guanines purple. Color the cytosines yellow.

The combination of a single base, a deoxyribose sugar, and a phosphate make up a nucleotide. DNA is actually a molecule or repeating nucleotides. Examine the nucleotides closer. Two of the bases are purines - adenine and guanine. The pyrimidines are thymine and cytosine. Note that the pyrimidines are single ringed and the purines are double ringed. Color the nucleotides using the same colors as you colored them in the double helix.

The two sides of the DNA ladder are held together loosely by hydrogen bonds. **<u>Color the hydrogen bonds gray</u>**. These aren't really so much bonds as magnetic attractions. If you can imagine that a single double helix of DNA is millions of base pairs long, and that each nucleotide on one strand has two or three hydrogen bonds with the nucleotide on the other strand, that is 2 to 3 million magnetic attractions. This makes the DNA molecule very stable. And, on the other hand, magnetic attractions are easier to break than covalent bonds are, so the two strands can be separated when it's time to copy the DNA.





DNA STRUCTURE

The Blueprint of Life

Every cell in your body has the same "blueprint" or the same DNA. Like the blueprints of a house tell the builders how to construct a house, the DNA "blueprint" tells the cell how to build the organism. 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. Think of your DNA as a cookbook that contains every recipe you'll ever need. If you want chocolate chip cookies, you only use the recipe for chocolate chip cookies. You might never make the "salmon mousse surprise", even though you have the recipe. A heart cell will make heart cell proteins according to the DNA recipe, but it won't make brain cell proteins.

Questions:

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

2. What is a gene?

3. Where in the cell are chromosomes located?

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

5. What three parts make up a single nucleotide?

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

7. What are the base pairing rules?

8. What type of "bonds" hold the two strands together in the middle?

9. What is the shape of DNA?