DNA Introduction

DNA Structure Background Information

\*\*\*Images shown in print, Figure 1, 2, 3, and 4. Ask your teacher for help with tactiles.

The shape of DNA in Figure 1 is called a double helix.

1) Each side of the double helix is called a strand. How many strands make up a double helix of DNA? \_

2) What do you think the word “helix” means in double helix? \_

DNA is a large molecule composed of repeating units.

3) Any large molecule made up of repeating units is called a (remember from first semester?)

DNA belongs to a category of polymers called Nucleic acids.

(remember from first semester?) \_

4) The repeating units of a polymer are called \_

The monomers of DNA are called nucleotides. A nucleotide is composed of a phosphate group, a deoxyribose sugar and a base.

5) The sugars and phosphates make up the outside of the double helix. What do the sugars and phosphates make up of DNA? (look at figure 1) \_

6) Which part of the nucleotides meet in the middle of the double helix? (Look at figure 1) \_

Figure 1 and Figure 2 both represent DNA. In figure 1, the two strands are twisted around each other. In figure 2 the strands are not twisted around each other.

Both images contain nucleotides.

In figure 1, the sugars and phosphates are only represented as blue strands (sometimes called ribbons). The bases are represented as the different colored cylinders in the middle.

In figure 2, the phosphates are the light blue circles. The deoxyribose sugars are the yellow pentagon shapes. The bases are the rectangular-ish shapes with either an A, T, C or G inside them.

The bases are attached to the inside, middle of a sugar.

The phosphates are attached above and below a sugar

7. Using figure 2 as a guide, label each part of a nucleotide in figure 3.

A:

B:

C:

The shape of DNA is sometimes referred to as a “spiral staircase.” Figure 1 is a good example of a double helix shape that can also be called a spiral staircase. Figure 2, however, does not twist or spiral. Sometimes the shape of DNA is referred to as a “ladder.” Figure 2 is a good example of DNA as a ladder.

A typical staircase/ladder is composed of steps (or rungs) and handrails.

8. Which part(s) of a nucleotide make up the steps (or rungs) of the “DNA ladder?”

9. Which part(s) of a nucleotide make up the handrails of the “DNA ladder?”

Look at figure 2. Notice there are four different types of bases. These bases are called nitrogenous bases (nitrogenous = contains nitrogen). You will see the complete structure of these bases at a later time.

10. What are the four different nitrogenous bases in DNA (names or single letter abbreviations are fine)?

Notice that the same two bases are always paired together. These are called complementary bases.

11. Which bases are complementary to each other?

Neither Figure 1 or Figure 2 show how the bases are attached/attracted to each other. The bases form Hydrogen bonds with each other! Hopefully you remember this term from the first semester. Hydrogen bonds form between a hydrogen on one base of DNA and either a nitrogen or oxygen on the complementary base of DNA. Here is a little more detailed view of two base pairs of a DNA molecule.

12. How many hydrogen bonds form between A and T? \_

13. How many hydrogen bonds form between C and G? \_

14. How many nucleotides are in Figure 4? \_

Another interesting feature about DNA seen in Figure 4. The two strands are antiparallel. This means the two strands are arranged in the opposite orientation of each other. Notice the left arrow is labeled 5’ → 3’ from bottom to top (also notice the oxygen of the sugars point up). The right strand, however, is labeled 5’ → 3’ from top to bottom (notice the oxygen of the sugars point down).

DNA Structure Gizmo

Launch the Building DNA Gizmo. You will first construct one double helix of DNA. You will then model DNA replication using your first double helix of DNA to create two new double helix of DNA!

Build the left side of your DNA molecule. Drag and drop the eight nucleotides in any order onto the nucleus of the cell. Notice you have to place the nucleotides under each other. You are building from top to bottom. Try placing a nucleotide above your first nucleotide. (he-he, you can’t!)

Now match the complementary nucleotides to build the right side of your DNA molecule. Notice you have to build from bottom to top.

1) Write out the sequence of your DNA double helix:

Left Base

Right Base

2) Why does the simulation make you build the right side of your DNA molecule from top to bottom, but the left side from bottom to top?

DNA Replication

You now have one DNA molecule. You will now see how DNA makes copies of itself.

DNA replication relies on a number of enzymes. Hopefully you remember what an enzyme is!

3) What is an enzyme?

Grab the DNA helicase enzyme from the “Enzyme DNA helicase” box. Drop the helicase onto your DNA molecule.

4) What did DNA helicase do (think about the bonds originally present between the bases)?

Grab the DNA polymerase enzyme from the “Enzyme DNA polymerase” box. Drop DNA polymerase onto your separated DNA strands.

On your left strand, add complementary nucleotides from the bottom to the top. On your right strand, add complementary nucleotides from the top to the bottom. You have now completed the process of DNA replication.

5) Look at the sequence of base letters on both strands. What do you notice?

6) How do these new base sequences compare to the original base sequence in the data table for question 1?

DNA replication is semi-conservative. This means that each new double helix produced in DNA replication contains one of the strands from the original DNA molecule and one newly created strand.

7) Look at the DNA molecule on the LEFT side of your gizmo.

a) Is the outside strand or inside strand from your original DNA molecule? \_

b) Is the outside strand or inside strand the newly created strand? \_

8) Look at the DNA molecule on the RIGHT side of your gizmo.

a) Is the outside strand or inside strand from your original DNA molecule? \_

b) Is the outside strand or inside strand the newly created strand? \_

9) In your own words, describe WHAT DNA polymerase did and HOW it did it?

What:

How:

Answer Key:

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1) 2

2) The two strands wrap/twist/spiral around each other

3) polymer

4) monomers

5) backbone

6) the bases

7) A: bases B: phosphates C: sugars

8) the bases

9) the sugars and phosphates

10) Adenine (A), Guanine (G), Thymine (T) and Cytosine (C)

11) A and T, C and G

12) 2

13) 3

14) 4

DNA Gizmo:

1) answers will vary

2) because the strands are antiparallel

3) An enzyme catalyzes (speeds up) a reaction or process

4) Helicase separates the two strands by breaking hydrogen bonds

5) The base sequences are exactly the same

6) The base sequence are exactly the same

7a) outside

7b) inside

8a) outside

8b) inside

9) Answers may vary. Ex:

What: DNA polymerase builds new strands of DNA after the helicase separates the two strands of the original double helix.

How: DNA polymerase will pair up complementary nucleotides with each base on the separated strands.

The End